Chapman Lakes
Strategic Lakes Management Plan
Kosciusko County, Indiana

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Executive Summary

This strategic lake management plan (SLMP) was developed for the approximate 4500-acre watershed draining to the natural lakes known as Big Chapman Lake and Little Chapman Lake. These lakes are located in the watershed designated by the14-digit Hydrologic Unit Code 07120005120106 within Kosciusko County, Indiana. The watershed is primarily agricultural and rural residential. Big Chapman Lake is considered to have above average water quality relative to other northern Indiana lakes, while Little Chapman Lake is considered to have average water quality compared with other northern Indiana lakes. Both lakes are heavily used for recreational pursuits. A task force was formed in 2005 to address concerns with declining water quality and the enjoyment of the lakes. Over 12 meetings were held by task force members and two public meetings were conducted to seek input on these concerns and issues and to develop potential solutions. As a result of the meetings, seven goals with measurable objectives and action items were developed. When implemented, these actions are intended to result in cleaner water and more enjoyment of the lakes for future generations.

The Chapman Lakes Task Force held several public meetings, reviewed available historical water quality data, and conducted current water quality sampling to identify water quality concerns in the Chapman Lakes watershed. Through the use of public notices and targeted mailings, property owners in the watershed as well as representatives from local, state, and federal natural resource agencies, not-for-profit organizations, and local governments were invited to attend the public meetings. As a first step toward addressing their three top concerns, the watershed stakeholders agreed on the following vision statement. The watershed stakeholders will use this vision to guide management efforts in the Chapman Lakes watershed.

Prolong the life of the lakes for enjoyment by current and future generations.

To address the issues in the Chapman Lakes watershed identified by watershed stakeholders, the stakeholders developed seven goals and developed an action plan for each of the goals. The goals in order of priority as agreed upon by the watershed stakeholders are as follows:

Goal 1: Improve the water quality in Big and Little Chapman Lake within ten years by lowering sediment and nutrient concentrations in the lakes and streams.

Goal 2: Consistently meet the state standards for concentration of *E. coli* bacteria within the Chapman Lakes and within the streams that flow into the lakes.

Goal 3: Educate a minimum of 50 percent of the landowners within the Chapman Lakes Watershed on at least one of the water quality issues facing the Chapman Lakes and have at least 50 percent of those landowners implement one water quality improvement project within the next 5 years.

Goal 4: Successfully manage the intensity of use in Chapman Lakes for the enjoyment of all users.

Goal 5: Successfully manage nuisance species of plants and animals on Big and Little Chapman Lakes.

Goal 6: Successfully manage the water level on Big and Little Chapman Lakes.

Goal 7: Maintain the Strategic Lakes Management Plan as the primary guide for improving the water quality and the quality of life within and around the Chapman Lakes.

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1.0 Introduction

The purpose of this Strategic Lake Management Plan (SLMP) is to create a framework or road map from which to pursue the goals and objectives identified by participating watershed stakeholders. Through the process of developing a plan, a community identifies issues, proposes a range of solutions, and prioritizes actions for future effort. Communities with approved plans are eligible to apply for continued funding from state and federal agencies for soil and water conservation practices in the state of Indiana.

This SLMP focuses on water quality improvements to the streams and lakes within the Chapman Lakes watershed as well as use and enjoyment of the Chapman Lakes by adjacent landowners and visitors. A watershed serves as a logical landscape unit considered in this SLMP for two reasons: 1) the area can be outlined on a map; and 2) working within a watershed makes sense for connecting water quality problems with their sources. Nonpoint source pollution—specifically sediment, nutrients, and bacteria (pathogens)—in the Chapman Lakes watershed originates from several sources around Big Chapman and Little Chapman lakes including the lakes' shoreline and areas that drain into the streams, storm drains, and ditches leading to the lakes.

1.1 Vision and Mission

At its strategic lakes planning meeting on June 8, 2005, the Chapman Lakes stakeholder group (Task Force) provided input on the development of a mission and vision statement for the Chapman Lakes Strategic Management Plan. A draft mission and vision statement and a concern prioritization survey were presented for community consent at the first public meeting on August 15, 2005. The following vision and mission were adopted as guiding statements for development of this SLMP.

Vision: Prolong the life of the lakes for enjoyment by current and future generations.

Mission: Develop an ever-changing plan that plots the path for maintaining and improving the health of the Chapman Lakes for long-term recreational enjoyment; increasing property values; improving environmental stewardship; and inspiring action by focusing on communication, collaboration, and education.

2.0 Historical context

The physical and social context provides a framework for determining the needs and possibilities for natural resource management. Both the physical features of the watershed and the organizational resources are necessary factors that shape the soil and water conservation approaches that will be most effective in the implementation of this SLMP.

2.1 Watershed description

This SLMP was developed for the 4,500 acre Chapman Lakes watershed (Figure 1). This watershed encompasses the natural lakes known as Big Chapman Lake and Little Chapman Lake, which are located within the 14-digit hydrologic unit known as (HUA05120106020030).

The 2001 *Chapman Lake Diagnostic Study* describes the watershed:

> These natural lakes are located approximately 5 miles northeast of Warsaw, Indiana in the southern portion of Kosciusko County. Together the lakes have an area of 638 acres (258 ha). The lakes' watershed stretches out to the east, north, and west of the lakes, encompassing approximately 4,500 acres (1,822 ha) or 7 square miles (18 km2). Water discharges through the lakes' outlet in the southwest corner of Little Chapman Lake to Heeter Ditch. Heeter Ditch is a tributary to Deeds Creek, which flows into Pike Lake in Warsaw. From Pike Lake, water drains to the Tippecanoe River eventually reaching the Wabash River and being transported to the Ohio River in southwestern Indiana (Giolitto and Jones, 2001).
>
> The Chapman Lakes have four main inlets from the east, some of which are dry during low flow conditions: Crooked Creek, Arrowhead Park Drain, Highland Park Drain, and Lozier's Creek (Table 1). A fifth drainage, Island Park Drain, which flows to the lake from the west, is included in the "area adjacent to lake" because the drainage is more of a wetland than it is a defined channel.

Table 1. Chapman Lakes Watershed and Subwatershed Sizes.

Stream Name	Area (acres)	Area (hectares)	% of watershed
Subwatershed			
Crooked Creek	775	313.80	17.0%
Lozier's Creek	839	339.70	18.40%
Arrowhead Park Drainage	303	122.70	6.60%
Highlands Park Drainage	122	49.40	2.70%
Area adjacent to lake	2,528	1,023.50	55.40%
Total watershed	4,567	1,849.00	100.00%
Watershed to lake area ratio	**7.6:1**		

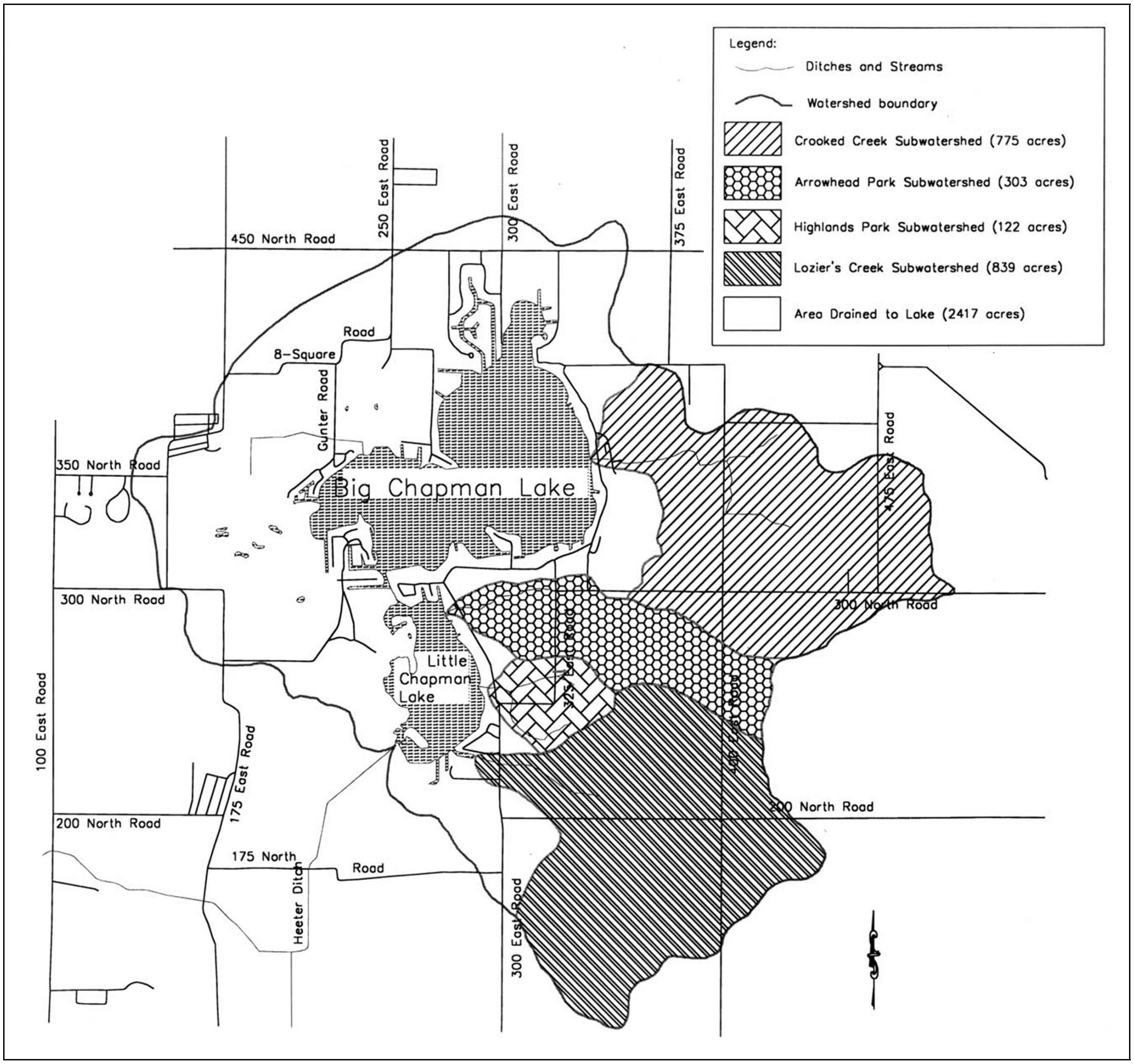


Figure 1. Chapman Lakes watershed and subwatersheds.

2.1.1 Local history and demographics

The U.S. government bought the land that is Kosciusko County from the Potawatomi Indians in 1832. The county's namesake is Thaddeus Kosciuszko, a Polish national hero and aide-de-camp to George Washington during the American Revolution. Kosciusko County was officially recognized in 1836. As the fourth largest of the state's 92 counties, it contains 558 square miles and more than 100 lakes. The city of Warsaw's website says that the lakes contribute heavily to the county's tourist and recreational economies. It also claims that Kosciusko County is a leading agricultural producing county in the state. Portions of Kosciusko County contain large deposits of marl. Warsaw, named for the capital of Poland, was platted in 1836 and incorporated in 1854 with 752 inhabitants. According to the city of Warsaw website:

> Early Warsaw contained traders, trappers and merchants supplying manufactured goods to the area's farmers. Because of its central location in the county's lake region, tourists soon began visiting Warsaw and made permanent residences in the city. Industry soon followed. The abundant water supply, growing labor force, close proximity to markets and energy sources provided industry with the basic needs for successful operations (City of Warsaw, 2005).

Warsaw is located along the historic Lincoln Highway (U.S. 30), America's first coast-to-coast highway. Warsaw has been named twice as one of the "Top 100 Small Towns in America." The current population is 12,672, and their motto is "Live, Work and Play."

Kosciusko County's economy shifted from primarily agricultural to an industrial mode starting in the 1950s and 1960s, when several large businesses made Warsaw home. R.R. Donnelley & Sons features one of the world's largest printing presses. Da-Lite Screen Company is the world's largest manufacturer of projection screens. Little Crow Foods, the makers of CoCo Wheats breakfast cereal, was an earlier industry; it was founded in Warsaw in 1903.

Tim Swarens wrote about Warsaw in "Keys to Success: Leadership, Skilled Workers and Vision" in the March 21, 2003, *Indianapolis Star*:

> *Back in 1895, [Revna] DePuy began making wooden splints, later switching to metal. The company he founded, DePuy Orthopedics, is still thriving. Company executives boast that not a single employee has been laid off in the firm's 108-year history.*
>
> *One of DePuy's employees, Justin Zimmer, started his own Warsaw-based company in 1927. Fifty years later, engineer Dane Miller left Zimmer Inc. to help start a company called Biomet. Three entrepreneurs with a vision. Three success stories.*
>
> *DePuy, Zimmer and Biomet are now three of the five largest orthopedic companies in the world. Together, they control about 30 percent of the global market and make more than half of the world's artificial knees and hips.*
>
> *Warsaw's orthopedics industry, which employs about 3,500 workers, is a testament to trickle-down economics. The average salary exceeds $71,000 a year, an astounding figure in a small Indiana town.*

Recession fell lightly in Kosciusko County, which rests securely in the top quarter of Indiana counties in terms of household income. Its poverty rate is near the bottom, 77th out of 92 counties, according to the 2000 Census.

In addition to the orthopedic industry, Warsaw is home to R.R. Donnelley & Sons, a printing company that employs about 1,400 workers. The world headquarters of Da-Lite Screen Co., a projection screen maker, sits on the edge of town. Explorer Van, the second largest van conversion company in the nation, is another major employer.

Online resources:
Websites for the city of Warsaw and Kosciusko County provide a plethora of information on the history of the area.

Demographic Data
Note: *Within this section, Kosciusko County is compared with surrounding counties of Marshall, Noble and Whitley counties (Table 2). These counties face growth and watershed issues or are otherwise similar to Kosciusko. Information for demographics data largely is derived from Indiana Business Resource Center's Stats Indiana, an online census information resource.*

In comparing 1990 and 2000 census data population estimates, Kosciusko County experienced a 13% population increase. Between 2000 and 2004, the population nudged upward slightly by 610 people or almost 1%. According to 2004 estimates, Kosciusko County has 140.8 residents per square mile and 537.5 square miles in land area. It is ranked 19th statewide for population size with 75,667 people.

Table 2. Population Data for Kosciusko and Surrounding Counties.

County	1990 Population (Rank)	2000 Population (Rank)	2004 Population (Rank)
Kosciusko	65,294 (21)	74,057 (19) *(13% increase over 1990)*	74,667 (19) *(14% increase over 1990)*
Marshall	42,182 (29)	45,128 (32) *(7% increase over 1990)*	46,732 (31) *(11% increase over 1990)*
Noble	37,877 (35)	46,275 (28) *(14% increase over 1990)*	47,297 (30) *(25% increase over 1990)*
Whitley	27,651 (51)	30,707 (52) *(11% increase over 1990)*	31,955 (52) *(16% increase over 1990)*

Population breakdown: Kosciusko County remains largely rural. The largest city is Warsaw, population 12,672, which contains the bulk of industry. Four towns have populations between 1,000 and 4,200 (Table 3). Nine other towns have populations under 1,000. The only city with possible bearing on the Chapman Lakes watershed is Warsaw, which eventually could expand into the watershed (Stats Indiana, 2005).

Table 3. City and Town Population Data in Kosciusko County.

City/Town	2004 Population	% of County	City/Town	2004 Population	% of County
Burket	193	0.3%	North Webster	1,058	1.4%
Claypool	307	0.4%	Pierceton	686	0.9%
Etna Green	645	0.9%	Sidney	158	0.2%
Leesburg	614	0.8%	Silver Lake	538	0.7%
Mentone	883	1.2%	Syracuse	3,033	4.0%
Milford	1,536	2.0%	**Warsaw**	**12,672**	**16.7%**
Nappanee	315	0.4%	Winona Lake	4,190	5.5%
Subtotal		**26,828**	**35.40%**		
Balance of county		**48,389**	**64.6%**		
Total		**75,667**	**100%**		

Race and language: Racial and language diversity was similar for Kosciusko, Marshall, Wabash, and Whitley counties and lesser than Indiana as a whole (Table 4). In Kosciusko County, race was defined as 94.6% white, compared to 87.5% for the entire state. African-American's make up 0.6%, American Indian/Alaskan natives make up 0.3%, Asians are 0.6%, other ethnic groups are 0.3%, and those who define themselves as two or more races are 1.1%.

Table 4. Percentage of Minority Population in 2000.

Area	Caucasian	African-American	American Indian/ Alaskan native	Asian	Other race	Two or more races*
County						
Kosciusko	94.6%	0.6%	0.3%	0.6%	0.3%	1.1%
Marshall	95.5%	0.3%	0.3%	0.3%	2.6%	1.6%
Noble	94.0%	0.4%	0.2%	0.4%	4.1%	0.9%
Whitley	98.4%	0.2%	0.4%	0.2%	0.3%	0.6%
Indiana	87.5%	8.4%	0.3%	1.0%	1.6%	1.2%

According to 2000 census data, in Kosciusko County, 8.4% of households spoke a language other than English at home. Residents who speak Spanish at home, while also speaking English "less than very well" totaled 2.3%. Between 1990 and 2000, county residents born outside the United States have more than doubled from 1990 to 2000 (from 310 to 683, a 120% increase), which was more than the state percent change of 97.9% (Stats Indiana, 2000).

Employment, economics and income: In 2004, 99% of Kosciusko County residents were employed in non-farm industries with the largest single sector in manufacturing (43%). Retail was the next largest employer at 11% (Table 5). Income from agriculture (the category also includes forestry, fishing and hunting) for county residents in the last quarter of 2004 was over $3 million. Income from nonfarm industries was over $330 million.

Table 5. Kosciusko County Covered Employment and Wages in Quarter 4 of 2004.

Industry	Jobs	Quarter Wages
Total	**34,259**	**$333,098,170**
Manufacturing	14,852	$196,595,853
Health Care and Social Services	2,841	$22,803,941
Retail Trade	3,601	$20,287,644
Educational Services	2,640	$15,594,132
Wholesale Trade	824	$14,049,233
Construction	1,246	$11,203,796
Public Administration	949	$6,584,542
Waste Management and Remediation Services	875	$5,918,524
Accommodation and Food Services	2,111	$5,660,029
Information	542	$5,202,898
Finance and Insurance	569	$5,135,577
Other Services (except Public Administration)	1,060	$5,703,562
Transportation and Warehousing	454	$4,117,728
Management of Companies and Enterprises	282	$3,902,435
Professional, Scientific and Technical Services	433	$3,883,486
Agriculture, Forestry, Fishing and Hunting	440	$3,056,634
Real Estate, Rental and Leasing	201	$1,663,945
Arts, Entertainment and Recreation	273	$988,800
Utilities	44	$513,255
Mining	22	$232,156

Lakes employment: Comparing county figures with Chapman Lakes responses to the Resident Survey, which was conducted in Fall 2005 as a part of this strategic lake study, indicate the largest employment sector represented by Chapman Lakes residents is professional/technical at more than 21% (Table 6). Manufacturing (13%) is the next largest employment sector; however, nearly 42% of the responding residents reported they are retired (Table 6).

Table 6. Chapman Lakes resident's employment

Profession/occupation:	
Manufacturing	13.42%
Retail Trade	5.19%
Health Care and Social Services	6.06%
Educational Services	6.49%
Accommodation and Food Services	0.87%
Construction	3.46%
Public Administration	0.00%
Agriculture	1.30%
Professional/Technical	21.21%
Other (retired)	41.99%

In 2000, median household income for Kosciusko County was $43,939 (19th), which was higher than the state median of $41,973, in comparison with median income in adjacent counties of Marshall (42,581), Noble (42,700) and Whitley (45,503).

Development
In 2004, 499 residential building permits were filed in Kosciusko County with a total value of $5.6 million. These consisted exclusively of single-family residences (94.4%). In 2000, median home value was $95,500 (ranking 26th) in comparison with adjacent counties of Marshall ($88,100), Noble ($88,600), and Whitley ($96,000).

In 2004, the total gross assessed value of the land and improvements in Kosciusko County was $5.173 billion according to Kosciusko County statistics. Four townships, Plain, Tippecanoe, Turkey Creek, and Wayne, represent 75% of this total value ($3.876 billion). The lakeshore property alone has a total gross assessed value of $1.438 billion. More than 37 percent of the entire property tax base for the four townships is lakeshore property.

In the results of a survey answered by 1,964 lake residents, more than half of the survey respondents:

- believe the quality of their lake is threatened by development (75%);
- believe the quality of their lake is threatened by greater numbers of motor boats (79%);
- indicate environmental quality is a major concern (90%); and
- the government should take action to protect lake quality (86%).

2.1.2 Natural history and climate
The 2001 *Chapman Lake Diagnostic Study* (Giolitto and Jones, 2001) describes Kosciusko County's natural history:

> The Chapman Lakes lie in the Upper Tippecanoe watershed immediately northeast of Warsaw, Indiana…. The Chapman Lakes and their watershed formed during the most recent glacial retreat of the Pleistocene era. The advance and retreat of the Saginaw Lobe of a later Wisconsin age glacier as well as the deposits left by the lobe shaped much of the landscape found in northeast Indiana. In Kosciusko County, the receding glacier left a nearly level topography dotted with a network of lakes, wetlands and drainages.
>
> The Chapman Lakes are located in the central portion of the Northern Lakes Natural Area. The Northern Lakes Natural Area covers most of northeastern Indiana where the majority of the state's natural lakes are located. Natural communities found in the Northern Lakes Natural Area prior to European settlement included bogs, fens, marshes, prairies, sedge meadows, swamps, seep springs, lakes, and deciduous forests. Upland areas at the higher topographical elevations were likely forested with oak and hickory species. Some remnant representatives of these forests still exist in the Chapman Lakes watershed. Wetlands likely bordered the lakes with red and silver maple, American elm, and

> green and black ash being the dominant species in forested areas and cattails, swamp loosestrife, bulrush, marsh fern, and sedges being the dominant species in more open areas. The high quality wetland habitat adjacent to the Chapman Lakes exemplifies this native landscape.
>
> Like much of the landscape in Kosciusko County, a large portion of the Chapman Lakes watershed was converted to agricultural land. Today, approximately 62% of the Chapman Lakes watershed is utilized for agricultural purposes (row crop and pasture). Property owners have developed much of the lake's northern, eastern, and southern shorelines.
>
> Despite these changes in land use, Big Chapman Lake has maintained fairly good water quality relative to many of the lakes in Kosciusko County. Studies on Big Chapman conducted over the past three decades confirm this. Some studies suggest water quality on Big Chapman may have improved slightly. Little Chapman Lake has not faired as well over the years. Historical studies show a decline in water quality from the early 1970's to today. The shallow basin morphology of Little Chapman Lake coupled with the lake's short residence time make it more sensitive to changes in its watershed.

Climate: The 2001 *Chapman Lake Diagnostic Study* (Giolitto and Jones, 2001) describes Kosciusko County's climate:

> The climate of Kosciusko County is characterized as cool and humid with winters that typically provide enough precipitation, in the form of snow, to supply the soil with sufficient moisture to minimize drought conditions when the hot summers begin. Winters are cold, averaging 26ºF (-3ºC), while summers are warm, averaging 70ºF (21ºC). The highest temperature ever recorded was 103ºF (39ºC) on July 17, 1976. Mild drought conditions do occur occasionally during the summer when evaporation is highest. Average relative humidity differs very little over the course of a day and is often 100 percent during summer months.

The average annual temperature in Kosciusko County is approximately 49 degrees. Similarly, between 1971 and 2000 the monthly normal precipitation ranged from a high of 4.51 inches in June to a low of 1.45 inches in February. The average annual precipitation is approximately 36.65 inches (Table 7; Applied Meteorology Group, 2006).

Table 7. Monthly Precipitation and Mean Temperature Normals in Kosciusko County (1971-2000).

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Precip. (inches)	1.85	1.45	2.08	3.36	3.83	4.51	3.67	4.05	3.22	3.05	2.87	2.62	36.65
Temp. (Fahrenheit)	22.80	26.70	37.50	48.20	59.60	68.40	72.20	70.00	63.00	51.50	39.90	28.30	49.00

2.1.3 Land use

The 2001 *Chapman Lake Diagnostic Study* (Giolitto and Jones, 2001) describes the Chapman Lakes watershed's land use:

> Approximately 62% of the watershed is used for agricultural purposes, including cropland, pasture and agricultural woodlots. This percentage is slightly below the percentage estimated for the county as a whole (72%). Wetlands and open water (the lakes) account for approximately 25% of the watershed. The residential community around the lakes occupies less than 5% of the total watershed (Table 8).
>
> The percentages of land uses shown in Table 8 change when considered on a subwatershed basis. Agricultural land use dominates the subwatersheds located east of the lakes. Agricultural land accounts for approximately 89% and 85% of the land in the Lozier's Creek and Crooked Creek subwatersheds, respectively. In contrast, agricultural land accounts for only 43% of the land draining directly to the lakes. Most of the watershed's wetlands are located along the western edge of the lakes. Most of the watershed's residential land is concentrated in the area draining directly to the lakes.

Table 8. Land Use in the Chapman Lakes Watershed.

Land use	Area (acres)	Percentage of watershed
Row crop	2,705.1	59.3%
Wetland	523.0	11.5%
Forested	368.3	8.1%
Residential/urban	221.8	4.9%
Pasture	140.0	3.1%
Open water	498.4	13.1%
Total	**4,556.6**	**100%**

Old maps and aerial photography from the 1900's to the present illustrate the development patterns around Big and Little Chapman Lakes. In his 1900 Report of the State, Geologist Blatchley describes the lake as being irregular in shape with flat gradual banks around some portions of the lake and steeper banks rising 20 feet (6 m) above the water level in other parts of the lake. (Blatchley considered Big and Little Chapman Lakes one lake, Little Eagle Lake.) He describes a narrow channel through marsh habitat connecting the main basin to its southern arm (Little Chapman Lake). Blatchley claims that the lake was lowered twice prior to his survey resulting in the exposure of the wetland flats along the western portion of Big and Little Chapman Lakes. He estimates the loss in surface area from this lowering to be approximately 150 acres.

A 1938 photograph of Big Chapman Lake and the northern half of Little Chapman Lake show the large wetland expanses on the west side of the lakes. Wetland fringes are also present along much of Big Chapman Lake, particularly around Nellie's Bay, the area immediately west of Nellie's Bay, the area west of Hog's Point, Osborn's Landing, and Arrowhead. Roads bordering the eastern shore and providing access to the lake at high points are visible in the photograph. With this access, it is likely that seasonal cottages dotted the eastern shoreline of both lakes by the late 1930's although large portions of the lakes remained undeveloped.

Photos of Big Chapman Lake from the late 1940's confirm the presence of seasonal cottages along the eastern and southern shorelines (Figure 2). Much of the northern and western portions of the lakes are undeveloped. The 1940's photographs show channels cut through the natural wetland fringe along the southern shoreline and around what will become the Arrowhead neighborhood. These channels provide further evidence of development around the lakes.

Figure 2. Late 1940's photo of Big Chapman Lake looking North.

Modern development around the lakes exploded in the late 1940's and 1950's. A 1957 photograph shows the development of channels in Nellie's Bay, Osborn's Landing, between the lakes, and in various places around the lakes. Much of the southern shoreline and parts of the northeast and northwest shoreline were dredged to provide access to the lake through the natural wetland fringe. Despite the presence of these channels, residences are largely confined to the eastern and southern portions of Big Chapman Lake and the eastern shoreline of Little Chapman Lake. A few homes are also located on Hog's Point, between the lakes, and Osborn's Landing.

Development of the lakes continued in the 1960's and 1970's. A 1964 Indiana Department of Natural Resources (IDNR) Fisheries Report states that nearly 90% of the Big Chapman Lake shoreline is developed (McGinty, 1964). The report notes 277 cottages and 51 trailer homes line the shore and channels on Big Chapman. By 1973, channels were cut through the wetlands west of Hog's Point and west of Island Park to support more development. Additional channels were added to Osborn's Landing and Nellie's Bay, providing more lakefront access. Homes dotted the Hog's Point and Arrowhead peninsulas. Increased density in the between the lakes area, Osborn's Landing, and along the northwest and eastern shorelines is also noticeable in the 1970's photographs. A 1976 IDNR Fisheries Report estimates that nearly 50% of the Little Chapman Lake is developed with 121 homes (Shipman, 1976).

Growth around the lakes began to taper-off in the 1980's and 1990's but it did not cease altogether. In a survey of lakes in Kosciusko County, Hippensteel (1989) reports 346 homes bordering Big Chapman Lake and 108 homes around Little Chapman Lake in 1980. Remodeling became more popular as space and new environmental laws limited new development of the existing shoreline on both lakes. Evidence of this is supported by the resident survey in which 75% of the respondents noted they had remodeled their house in the past 20 years. In some cases, cottages were razed and replaced with newer residences in which property owners lived full time rather than seasonally.

Currently, approximately 548 residences (houses, cottages, and trailer homes) line the shoreline and channels of Big Chapman Lake, while 175 residences border Little Chapman Lake. Numerous homes that do not lie on lakefront property also exist around the lakes. As indicated by the resident survey, most of these homes are more than 20 years old (80%). Seawalls protect nearly 80% of these lakefront homes. No significant areas of shoreline erosion were noted during a shoreline reconnaissance survey, likely due to the heavy seawall use on the lakes. The seawalls consist largely of concrete and rock materials. Concrete seawalls are most common in areas that were formerly wetland habitat, although their presence was noted along other areas of the shore as well. Maintained lawns are common habitat behind seawalls. Natural shoreline fronted few residences.

While seawalls provide some temporary erosion control along shorelines, they cannot provide all the functions of a healthy shoreline plant community. Native shoreline communities filter runoff water to the lake, protect the shore from wave action limiting erosion, release oxygen to the water column for use by aquatic biota, and provide food, cover, and spawning/nesting habitat for a variety of fish, waterfowl, insects, mammals, and amphibians. Removal of the native plant community eliminates many of these functions.

2.1.4 Soils, topography and wetlands

Soil types and slopes are pertinent for the purposes of this document to the extent that they affect the identification of best management practices to control erosion and nutrient runoff. Knowing the location and extent of major soil associations, hydric soils and highly erodible soils can guide planning decisions as they affect runoff coeffients, erodibility and selection of appropriate measures at particular sites.

Soils: A detailed description of Kosciusko County's soil types is presented in the 2001 *Chapman Lake Diagnostic Study* (Giolitto and Jones, 2001). An excerpted description is presented here:

> ... The soil types found in Kosciusko County are a product of the original parent materials deposited by the glaciers that covered this area 12,000 to 15,000 years ago. The main parent materials found in these two counties are glacial outwash and till, lacustrine material, alluvium, and organic materials that were left as the glaciers receded. The interaction of these parent materials with the physical, chemical, and biological variables found in the area (climate, plant and animal life, time, and the physical and mineralogical composition of the parent material) formed the soils of Kosciusko County today.
>
> ...Soils in the watershed, and in particular their ability to erode or sustain certain land use practices, can impact the water quality of a lake. For example, highly erodible soils are, as their name suggests, easily erodible. Soils that erode from the landscape are transported to waterways or waterbodies where they impair water quality and often interfere with recreational uses by forming sediment deltas in the waterbodies. In addition, such soils carry attached nutrients, which further impair water quality by fertilizing macrophytes (rooted plants) and algae. Soils that are used as septic tank absorption fields deserve special consideration.
>
> ...Only 50 acres (20 ha) of land are mapped as highly erodible soils in the watershed (Table 9). This acreage is concentrated in the upper reaches of the Lozier's Creek subwatershed and north of the Island Park neighborhood in the northwest corner of Big Chapman Lake. Approximately 1,334 acres (540 ha) of

land in the watershed are mapped in potentially highly erodible units. By subwatershed, the Crooked Creek subwatershed has the greatest percentage of land (50%) mapped as potentially highly erodible units. Together, the Lozier's Creek and Highlands Park subwatersheds drainage nearly equal that percentage; approximately 47% of the land in each of those subwatersheds is mapped in potentially highly erodible units. The Arrowhead Park subwatershed and land that drains directly to the lakes have lower percentages of land mapped in potentially highly erodible units (31% and 21%, respectively).

Table 9. Area Mapped in Highly Erodible or Potentially Highly Erodible Map Units by Subwatershed.

	Highly Erodible Soil		Potentially Highly Erodible Soils	
Subwatershed	**Acres**	**% of Watershed**	**Acres**	**% of Watershed**
Crooked Creek	0	0%	389.2	50.2%
Lozier's Creek	28.3	3.4%	392.0	46.8%
Arrowhead Park Drainage	0	0%	92.6	30.6%
Highlands Park Drainage	0	0%	52.2	47.0%
Area adjacent to lake	21.8	2.8%*	408.6	21.3%
Total	**50.1**	**1.3%**	**1,334.6**	**33.8%**

The study offers a description of flooding and water storage in Kosciusko County:

> The soil usually becomes saturated with water several times during the winter and spring. The water table offers abundant water storage in ancient lake and stream beds which are currently overlain by glacial deposits from the Pleistocene glacial recession. Flooding is common in Indiana and occurs in some part of the state almost every year. The months of greatest flooding frequency are December through April. Causes of flooding vary from prolonged periods of heavy rain to precipitation falling on snow and frozen ground.

The report offers further summation of watershed soils, land practices and recommendations for the Chapman Lake area:

> The type of soils in a watershed and the land uses practiced on those soils can affect a lake's health. Highly erodible soils are concentrated northwest of Big Chapman Lake and in the southern portion of the watershed. Soil erosion contributes sediment to the lakes reducing the lake's water quality and interfering with recreational uses of the lakes. Nutrients attached to eroded soils will help fertilize algae and rooted plants. Consequently, conservation methods and best management practices (BMPs) should be utilized when soils are disturbed in

these areas. This includes development of shoreline property as well as farming in highly erodible soils.

Soil type should also be considered in siting septic systems. Some soils do not provide adequate treatment for septic tank effluent. Much of the Chapman Lakes shoreline is mapped in soils that rate as severely limited or generally unsuitable for use as a septic tank absorption field. This is typical for much of Indiana. Research by Dr. Donald Jones suggests that 80% of the soils in Indiana are unsuitable for use as a septic tank absorption field. The increased density of housing and the conversion of summer cottages to fulltime living quarters have exacerbated the situation.

The resident survey indicates that conversion of summer cottages to fulltime living quarters has occurred around the Chapman Lakes. Thirty nine percent of the respondents who owned new homes (1+ years) reported having septic systems older than 5 years old. It cannot be determined from the survey if these septic systems are appropriately sized for the newer residence, which are likely larger than the original residence serviced by the septic system. Over fifty percent of the survey respondents noted that they have remodeled their home in the past 15 years. Sixty seven percent of the respondents stated that their residences were equipped with washing machines. These results confirm that the property owners around the lakes are upgrading their homes. Adjustments in septic systems (tank and field size) should accompany any modernization to ensure the system is capable of handling the increased effluent stream.

Pollution from septic tank effluent can affect a lake and its users in a variety of ways. It can contribute to eutrophication, or nutrient enrichment, of the lake, which impairs the lake water quality. The nutrients present in septic tank effluent can fertilize algae and macrophytes in the lake promoting algae blooms and macrophyte growth. In addition, septic tank effluent potentially poses a health concern for lake users. Swimmers, anglers, or boaters that have body contact with contaminated water may be exposed to waterborne pathogens. Fecal contaminants can be harmful to humans and cause serious diseases, such as infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illness.

Topography: The 2001 diagnostic study summarizes topographical features:

The Chapman Lakes and their watershed formed during the most recent glacial retreat of the Pleistocene era. The advance and retreat of the Saginaw Lobe of a later Wisconsian age glacier as well as the deposits left by the lobe shaped much of the landscape found in northeast Indiana (Homoya et al., 1985). In Kosciusko

County, the receding glacier left a nearly level topography dotted with a network of lakes, wetlands and drainages. [34]

The United States Geological Survey topographical map displays the topography associated with the Chapman Lakes area. The topography of the Chapman Lakes watershed is typical of much of Kosciusko County. Land to the east of the lakes exhibits a gently rolling topography. Relief ranges from approximately 940 feet above MSL at the highest point in the watershed to approximately 828 feet at the lakes. Land to the west of the lakes is flatter than the land to the east of the lakes with large wetland expanses lying adjacent to the lakes.

Wetlands: The 2001 diagnostic study describes wetlands in the Chapman Lakes watershed:

Because wetlands perform a variety of functions in a healthy ecosystem, they deserve special attention when examining watersheds. Functioning wetlands filter sediment and nutrients in runoff, store water for future release, provide an opportunity for groundwater recharge or discharge, and serve as nesting habitat for waterfowl and spawning sites for fish. By performing these roles, healthy, functioning wetlands often improve the water quality and biological health of streams and lakes located downstream of the wetlands. The land use table above (Table 8) indicates that wetlands account for approximately 11.5% of the Chapman Lakes watershed. Table 10 presents the acreage of wetlands by type.

Table 10. Acreage and Classification of Wetland Habitat in the Chapman Lakes Watershed.

Wetland Type	Area (acres)	% of watershed
Forested	88.2	1.9%
Shrubland	284.9	6.3%
Herbaceous	149.9	3.3%
Total	**523**	**11.5%**

Source: Indiana Gap Analysis Project

The IDNR (Indiana Wetland Conservation Plan, 1996) estimates that approximately 85% of the state's wetlands have been filled. The greatest loss has occurred in the northern counties of the state such as Kosciusko County. The last glacial retreat in these northern counties left level landscapes dotted with wetland and lake complexes. Development of the land in these counties for agricultural purposes altered much of the natural hydrology, eliminating many of the wetlands. The 1978 census of agriculture found that drainage is artificially enhanced on 38% of the land in Kosciusko County. Residential development has also decreased the wetland acreage in the watershed. A review of aerial photographs suggests large portions of the Chapman Lakes shorelines were originally wetland habitat. These wetlands were filled to support lakeshore houses.

To estimate the historical coverage of wetlands in the Chapman Lakes watershed, hydric soils in the watershed were mapped.... (As noted for the highly erodible soils map, this map is based on the Natural Resources Conservation Service criteria for hydric soils and is not field checked.) Because hydric soils developed under wet conditions, they are a good indicator of the historical presence of wetlands. Comparing the total acreage of wetland (hydric) soils in the watershed (1064 acres or 430.8 ha) to the acreage of existing wetlands (523 acres or 211.7 ha) suggests that only approximately 49% of the original wetland acreage exists today. Table 11 examines wetland loss by subwatershed. The Highland Park subwatershed has experienced the greatest loss with no wetland acreage existing today. The Crooked Creek, Lozier's Creek and Arrowhead Park subwatersheds have suffered significant wetland losses as well with only 12%, 15% and 18% of the original wetland acreage remaining today. Wetland loss immediately adjacent to the lakes is less severe…. Many areas mapped in this unit were originally marsh areas that were filled with soil for development. Loss in wetland acreage throughout the watershed results in a loss of wetland functions, many of which improve water quality. Restoration of at least some of the wetlands could restore some of these functions.

Table 11. Acreage of Wetland Loss in the Chapman Lakes Watershed.

Subwatershed	Hydric soil in acres	Wetland area in acres	% wetland remaining
Crooked Creek	216.5	30.4	12%
Lozier's Creek	230.5	33.7	15%
Arrowhead Park Drainage	61.6	10.9	18%
Highland Park Drainage	21.6	0	0%
Area adjacent to lakes	533.6	448	84%
Total	**1,063.8**	**523**	**49%**

2.1.5 Hydrology and water use

Changes in land management in the watershed immediately adjacent to the lake can have a fairly rapid effect on water quality in Chapman Lakes. The watershed to lake surface ratio is low at 7.6:1, indicating that much of the water quality impacts are focused on activities in and immediately around the lake itself. Rainfall on the watershed does not produce enough volume to completely flush the lakes. A significant amount of the nutrient loading is coming from within the lakes. Therefore, changes in watershed management may have little effect in the short-term on water quality until these "legacy" nutrients are flushed through the system.

Big Chapman Lake has a relatively long retention time. Water turns over every three years in Big Chapman compared to every two years in Little Chapman. Fortunately, successful restoration of Little Chapman Lake's water quality may be achieved more quickly given its relatively shorter hydraulic residence time. A short residence time means the lake is regularly flushed with runoff from the watershed. When this watershed runoff contains a high concentration of pollutants, the lake receives regular inputs of these pollutants. If improvements are made in the watershed to reduce pollutant loads, the lake with a shorter residence time will have a speedier recovery than a lake with a longer residence time since it is continually flushed with clean water.

The drought during 2005 resulted in virtually no water flowing over the fixed-level outlet structure for more than two weeks in the late summer. With no major tributary inflow, the Chapman Lakes depended upon groundwater and rainfall to maintain water levels. Since the dam and levee were replaced in 2005, lake levels have returned to normal conditions.

Most streams or drainages in Indiana are considered “legal drains”. This legal designation allows the county drainage board to generate revenue from land benefiting from drain construction, repair, evaluation or maintenance according to regulations associated with state Drainage Law (IC 36-9-27). The county surveyor, the board, or an authorized representative of the surveyor or the board acting under this chapter has the right of entry upon land lying within seventy-five (75) feet of any regulated drain. Designated legal drains in the Chapman Lake watershed are limited to Crooked Creek, Arrowhead Drain, and Lozier Drain.

According to IDNR Division of Water records, which are available in graphic format for the time period from 1986 to 1998, industry was the largest user of surface water in Kosciusko County and was steadily increasing over this time period to over 800 million gallons per year. Agricultural withdrawals of surface water in Kosciusko County were relatively flat at around 400 million gallons per year. Use of surface water for public water supplies increased steadily from less than 200 million gallons per year to over 400 million gallons.

Agriculture was the largest user of groundwater in the county at times. Groundwater withdrawals for agriculture increased from about 800 million gallons per year in the mid-1980s to a peak of just less than 3,000 million gallons in 1995; low periods of use were in 1990, 1992 and 1997. Industrial and public water supply uses of groundwater fluctuated between 1,000 and 1,300 million gallons per year over this time period for each use. Rural groundwater use was relatively low but increased from nearly zero in 1992 to 60 million gallons per year in 1995. No surface or ground water withdrawals for energy production were indicated.

Online resources:
IDNR Division of Water: Public freshwater lake legal and average normal water levels
http://www.in.gov/dnr/water/surface_water/lake_levels/

IDNR Division of Water countywide water withdrawal data
http://www.in.gov/dnr/water/water_availability/trends/pdf/k-m.pdf

2.1.6 Recreational use of the landscape

Kosciusko County has numerous recreational facilities. Among Kosciusko County's lakes are Indiana's largest (Lake Wawasee near Syracuse) at over 3,000 acres and deepest (Tippecanoe Lake north of Warsaw) at nearly 120 feet. Warsaw has three lakes within its corporate limits (Center, Pike and Winona lakes), offering all types of water sports. Only four of the 17 townships in the county do not have any lakes. Most of the lakes are located north of U.S. 30. There are 12 lakes within the state-owned Tri-County Fish and Wildlife Area, managed by the Indiana Department of Natural Resources. There's more to Kosciusko County than just lake though. More than 3,000 softball and soccer games are played annually at Warsaw's City-County Athletic Complex. And, more than 20 golf courses are located within 45 minutes of Warsaw. Within the watershed, the Chapman Lakes offer the primary recreational opportunities.

2.1.7 Cultural resources

Within the watershed, there are no Indiana properties listed on the state and national historic registers.

2.1.8 Endangered species

The 2001 diagnostic study describes endangered species in the watershed:

> The Big Chapman Lake Nature Preserve area supports four different high quality community types according to the database: marl beach, marsh, sedge meadow, and shrub swamp wetlands. These high quality communities provide habitat for three state endangered animal species, the northern harrier (*Circus cyaneus*), the Virginia rail (*Rallus limicola*), and the blanding's turtle (*Emydoidea blandingii*). Circumneutral bogs, marsh wetlands, and sedge meadow wetlands have been documented within the Little Chapman Lake Nature Preserve. The wetland community in this area is inhabited by the marsh wren (*Cistothorus palustris*), least bittern (*Ixobrychus exilis*), black-and-white warbler (*Mniotilta varia*), black-crowned night-heron (*Nycticorax nycticorax*), king rail (*Rallus elegans*), Virginia rail (*Rallus limicola*), and the golden-winged warbler (*Verivora chrysoptera*). All of these birds are state endangered species or species of special concern. The state endangered blanding's turtle and the state rare green-keeled cotton-grass (*Eriophorus viridicarinatum*) were also observed within the Little Chapman Lake Nature Preserve, which borders the western shoreline of Little Chapman Lake.

2.2 Organizational interests, institutional capacity and social resources

A thorough assessment of the organizations that may be available to implement land and water conservation practices is useful in determining current organizational capacity, feasibility of various solutions and to project community needs for the future.

2.2.1 Governmental organizations

Several regional and local governmental organizations provide services to the Chapman Lakes and watershed residents. These organizations are described in more detail below.

2.2.1.1 Kosciusko Board of County Commissioners

A board of three county commissioners governs each Indiana county, except for Marion County. In all except Lake and St. Joseph counties, the commissioners are elected from separate commissioner districts by vote of the county as a whole. The board of county commissioners constitutes the legislative body of most counties for ordinance making purposes.

In general, the board of county commissioners is responsible for the administration of all county business. The commissioners may enact ordinances to meet local conditions and exercise other authority vested in the board by the legislature. In Kosciusko County, the Board of County Commissioners serve as the executive and administrative authority. They control, maintain and supervise county property; audit and authorize claims against the county; receive bids and authorize contracts; supervise construction and maintenance of roads and bridges; appoint certain county and township officials; perform certain election functions; and serve on the board of county finance. The terms of office of county commissioners are four years on a staggered basis. The commissioners meet every other Tuesday at 9 a.m. with a calendar of meetings slated at the beginning of each year.

As of January 2006, county commissioners are:

Bradford Johnson	North District
Ronald Truex	Middle District
Bob Conley	South District

2.2.1.2 Kosciusko County Drainage Board

The Kosciusko County Drainage Board comprises one county commissioner, three appointed members, and the county surveyor. The county surveyor is an ex-officio, non-voting member of the board. In this capacity, the county surveyor is the technical authority on the construction, reconstruction, and maintenance of all regulated drains or proposed regulated drains in the county. The board and surveyor have jurisdiction over regulated drains. Regulated drains are drains established by either the commissioners' court or circuit court of each county prior to 1965 or the drainage board since 1965. These drains are open ditches or tile drains or a combination. These can also be municipal storm sewers. The county surveyor also is normally a member of the county plan commission. As a member of the commission they attend the monthly meeting, hear and make decisions on subdivisions and planning, and provide technical review of plats. The Kosciusko County Drainage Board meets the fourth Thursday of each month at 9 or 9:30 a.m.; the exception is in November and December, when they meet on the third Thursdays.

As of January 2006, drainage board members are:

Ron Truex	Chairman	Eldon Watkins	Member
Donald Goon	Vice Chairman	Dorris Harrold	Member
Maurice McDaniel	Member	Richard Kemper	Kosciusko County Surveyor

2.2.1.3. Kosciusko County Soil & Water Conservation District

The Kosciusko County Soil & Water Conservation District is a governmental subdivision of Indiana. It is an independent body formed under and subject only to the Indiana Soil and Water Conservation District law. It is responsible for carrying out practices and programs that promote the conservation of our soil, water, and related natural resources within the county. By working in partnership with the Natural Resources Conservation Service (NRCS) and the IDNR, this purpose is carried out by providing technical assistance, cost-share opportunities, and educational programs.

The SWCD was organized by landowners of its 17 townships: Clay, Etna, Franklin, Harrison, Jackson, Jefferson, Lake, Monroe, Plain, Prairie, Scott, Seward, Tippecanoe, Turkey Creek, Van Buren, Washington, and Wayne. The Chapman Lakes watershed lies entirely within Plain Township.

The district is controlled by a board of five local supervisors, three elected by the landowners in the district and two appointed by the State Soil and Water Conservation Board. The supervisors meet on the 1st Thursday of each month at 7 or 7:30 p.m. to conduct the district's business and attend other meetings in and out of the county. They serve their community without pay.

Supervisors are responsible for providing leadership in the conservation and development of soil, water, and related resources within the district's boundaries. The major purpose of the district is to analyze needs and develop and carry out both short and long range programs aimed at solving resource problems, primarily dealing with soil and water resources. The ultimate district objective is to cause soil and water conservation practices and systems to be implemented upon the land.

Supervisors and staff work with both rural and urban dwelling landowners or occupiers, groups, local agencies, and others to prevent resource problems, correct existing soil and water conservation problems, and help utilize the county's natural resource capabilities. Through the district, local people are also better able to organize and coordinate their efforts in obtaining technical and financial assistance from state and federal agencies with responsibilities and expertise in natural resource use and development.

As of January 2006, members are:

Jon Roberts	Chair
Gary Tom	Supervisor
Sherman Bryant	Supervisor
Roger Miller	Supervisor
Jamie Scott	Supervisor

Online resources:
Kosciusko County SWCD http://www.kosciuskoswcd.com/

2.2.1.4 Kosciusko County Area Plan Commission: This entity is in charge of land use and development issues. Commission duties include: addressing land use questions; reviewing all proposed subdivision plats; presenting all rezoning recommendations to the county commissioners and town boards; issuing all improvement location permits for properties located within our jurisdiction; issuing permits for all on–premise and off–premise signs; enforcing Kosciusko County zoning, subdivision control, mobile home park control, stormwater and erosion control, and flood control ordinances; facilitating the Kosciusko County Board of Zoning Appeals and Area Plan Commission meetings; and issuing addresses for properties located in the unincorporated areas of the county. The plan commission meets the first Wednesday of every month. There are nine members on the area plan commission, and there is an area plan commission staff, which is led by Daniel Richard, director.

As of January 2006, members are:
Anthony Etienne
Charlene Knispel
Kevin McSherry
Norm Lovell
Victor Virgil
Charles Haffner
Larry Coplen
Richard Kemper
Bob Conley

2.2.1.5 Purdue University Cooperative Extension Service: The Purdue Cooperative Extension maintains offices in Kosciusko County with staff dedicated to the education of Indiana citizens through the application of land-grant university research and the knowledge base to develop youth and strengthen agriculture, families, and communities. The representative for Kosciusko County maintains an office space within the USDA Services center along with the SWCD, Farm Services Agency (FSA), and Natural Resources Conservation Service (NRCS).

Online resources:
Purdue Cooperative Extension
http://www.ces.purdue.edu/kosciusko/

2.2.1.6 County wastewater treatment facilities

Kosciusko County has no regional sewer district. The following describes water treatment facilities near the Chapman Lakes watershed.

The city of Warsaw has two wastewater treatment facilities. Wastewater treatment plant #1 was built in 1949. The facility is in operation after several upgrades and additions over the decades. It is a conventional activated sludge plant with grit removal, primary treatment, secondary treatment, and final clarifiers. During the months of April through October, chlorine is used to disinfect the treated wastewater and sulfur dioxide is used to remove the residual chlorine before discharge to Walnut Creek (a tributary to the Tippecanoe River). It treats, on average, a million gallons of water per day. Wastewater treatment plant #1 has a single combined sewer overflow that can discharge a combination of stormwater and untreated wastewater into Walnut Creek during a heavy rain storm or snow melt. A new facility (wastewater treatment plant #2) was operational in November 2003; it treats wastewater using an extended aeration activated sludge process. The second plant treats, on average, more than one million gallons per day. Both facilities service the Warsaw, Winona Lake, and Pike Lake areas and have no plans in place for expansion to the Chapman Lakes area.

2.2.1.7 State agencies

Several state agencies provide services to the watershed residents, including the Indiana Department of Natural Resources (IDNR) and Indiana Department of Environmental Management (IDEM).

Among many natural resource related duties, the IDNR-Division of Water is charged with regulating activities in Public Freshwater Lakes and within designated floodways. IDNR Fish and Wildlife Staff oversee the LARE program, surveys and reports on fish and wildlife populations, and provides significant comment on permit applications for the Division of Water. The IDNR Division of Law Enforcement (Conservation Officers) are charged with the enforcement of all IDNR rules for watercraft, fishing, hunting, trapping, and the possession or transport of fish and wildlife. Most of the local IDNR staff are now located in Columbia City, in the former REMC building and adjacent to the USDA farm services center. The central office staff are still located in Indianapolis.

IDEM has two branches that may be helpful to watershed resident, the Water Quality Branch and the Biological Survey Branch. The Water Quality staff includes regulatory people who enforce water quality standards through permit and enforcement activities and staff who operate the grants provided by the Federal government to improve water quality in the state of Indiana. Most of the IDEM regulatory staff are located in Indianapolis. The Biological survey section works out of public view to survey Indiana waterways for fish and macroinvertebrates and to measure contaminant levels. This staff is also located in Indianapolis.

2.2.1.8 Federal agencies

The Federal agencies that may be able to provide services to watershed residents include the Farm Service Agency (FSA), Natural Resources Conservation Service (NRCS), the Arrowhead Resource Conservation and Development Board (RC&D), and the US Army Corps of Engineers (ACOE). The FSA is charged with administering compliance with Federal farm bill programs including crop payments, set asides, tillage methods, and animal waste handling. The NRCS is the technical design and installation support for farm programs as well as non-farm programs to reduce erosion and nutrient run off from the landscape. Both the FSA and NRCS are located in the same building with the SWCD. The RC&D was developed to promote rural economic development. Their limited staff (usually 1 or 2 people per 4 to 6 county district) can assist in projects that reduce erosion from agricultural ground. The Louisville office of the Army Corps of Engineers, which has jurisdiction over "waters of the United States," has an Indianapolis field office for regulatory staff to enforce Clean Water Act regulations. Other ACOE staff that may be of assistance are within the Engineering branch. The engineering branch designs and oversees construction on large public works projects when authorized by congress.

2.2.2 Nongovernmental organizations

The following two nongovernmental organizations (NGOs) serve the community around the Chapman Lakes watershed: the Chapman Lakes Conservation Association and the Chapman Lakes Foundation.

2.2.2.1 Chapman Lakes Conservation Association (CLCA)

Serving Chapman Lakes, Warsaw, Indiana, for more than 50 years, CLCA, is "a non-profit property owner's and resident's organization dedicated to preserving and conserving our natural lakes' heritage, and thereby also preserving homeowners' future as well." Today, CLCA concentrates on lake enhancement projects in cooperation with the Chapman Lakes Foundation, Inc., which was organized by CLCA members to fund major projects. CLCA conducts a full range of community fundraising activities during the summer months. The association's "clubhouse" was built in 1947 by the then Chapman Lake Conservation Club, a merging of several small lake organizations at the time. The clubhouse includes a fully equipped commercial kitchen for fund-raising events.

A Class 1, Voting Membership in CLCA requires that the member own or occupy property that is shoreline, on a channel to either lake, or has direct deeded access to either lake. The result of that requirement is that the organization is effectively a property owner association. Representing the membership, CLCA is pro-active in lake zoning and watershed issues, including control of sediment erosion that could find its way into either lake, as well as pollutants and water quality.

In June 2005, CLCA established "CLCA Scientific", intended to provide the organization with a broad range of water quality measurements well beyond those undertaken by state agencies on an infrequent basis. Water chemistry samples are collected and analyzed at numerous sites around both lakes, usually every other week throughout the year when the lake and channels are free of ice.

CLCA's major activities include lake enhancement projects to protect or improve lake water quality, and lake education designed to help newcomers and those who visit enjoy the lakes more fully without endangering the delicate balance of the lakes and properties.

Funding is distributed as follows:

1. One-half of all dues receipts go to the lake enhancement fund; the balance helps pay for membership communications and meetings, including the “Making Waves” newsletter.
2. The lake enhancement fund supports printed materials for public lake education and small lake enhancement projects. (The CLF Foundation funds major projects.)
3. Proceeds from pancake breakfasts and fish fries support costs to maintain the clubhouse; send kids to conservation camp; and occasionally provide hunting and boating safety classes.
4. Independence Day fireworks contributions stay in a separate fund to pay for that one-day event that usually includes a flotilla and fireworks. The $8,000 fireworks display is supported entirely by separate contributions. According to board policy, if the independence celebration fund ever has a surplus, over and above the anticipated next year’s costs, a portion of the surplus could be transferred into the lake enhancement fund.

Although contributions to CLCA are not tax deductible, those who wish to contribute and desire tax deductibility can donate to Chapman Lakes Foundation, Inc. It is the foundation that funds major lake enhancement construction, not CLCA. Individuals who do not live at the Chapman Lakes can become associate members.

Chapman Lakes Conservation Association, Inc., initiated the Chapman Lake Diagnostic Study in 2001; an engineering feasibility study of Crooked Creek, Arrowhead Drain, and nine roadside drains in 2003; completed the Chapman Lakes Aquatic Plant Management Plan in 2005; and continues to monitor and update the aquatic plant management plan. The large membership and numerous activities of CLCA provide Chapman Lakes Foundation with information necessary for that organization to identify and proceed with lake enhancement projects.

2005-2006 CLCA governing board members are:

Tom Ross	President
Dan Lee	Vice-President
Fran Nichols	Secretary
Amanda Lee	Treasurer
Les Kreger	Chairman of the Board/Director
Kathy Kostro	Director
Larry Gaerte	Director
Mark Ganger	Director
Don Holle	Director
Bill Magurany	Director
Bill Curts	Director

2.2.2.2 Chapman Lakes Foundation, Inc.

The foundation is a non-profit organization specifically organized to finance major lake enhancement projects and construction efforts with lake resident contributions.

Organized in 2001 by CLCA members, the Chapman Lakes Foundation, Inc. (CLF) is responsible for raising the funds necessary to carry out major lake enhancement projects benefiting Chapman Lakes. CLF has been designated a tax-exempt 501(c)(3) charitable foundation by the Internal Revenue Service. As a result, contributions to the foundation are tax-deductible. Because CLF is a charitable foundation it does not become involved in political issues.

Projects that received foundation funding include recently completed erosion control improvement projects for Crooked Creek and Arrowhead Drains, an engineering feasibility study for Highland Park and Lozier drains, and aquatic plant management and control measures. This strategic lakes management plan is funded through the foundation. In 2001, CLF embarked on a 5-year program to fund more than $600,000 in needed projects to protect the Chapman Lakes from further water quality deterioration.

2006-2007 Chapman Lakes Foundation, Inc., governing board members are:

Greg Hall	President
Sharon Sanders	Secretary
Linda Bruner	Director
Leonard Draving	Director
D. C. “Dan” Lee	Director
Frank Manwaring	Director
Thomas Ross	Director
Pete Smith	Director
Donald Spitler	Director
Howard Woodward, Jr.	Director

2.2.3 Institutional relationships

The CLCA and the CLF are working together to accomplish the vision and the mission of this SLMP. While this document is funded by the CLF, it is the CLCA that will provide the membership resources to implement the action items identified in latter sections of this plan. The directors within both of these organizations are also a part of many other local and national organizations whose resources may be tapped for implementing specific goals and objectives identified in this SLMP.

3.0 Analysis: process of developing the plan

When developing the SLMP, it was vital to have flexibility in guiding the process. The Chapman Lakes community is innovative. The resulting SLMP does more than just meet the technical requirements of the LARE program. The plan focuses specifically on public information and education solutions that strive to solve concerns about the lake's water quality and use. The result will be an immediate and long-term impact on the lake's health.

3.1 Public participation

Active stakeholder awareness and involvement is essential for the development and implementation of a strategic plan. Leaders in the Chapman Lakes community have long recognized the need to provide information that generates responsive action on behalf of the short and long-term interests of land and water management.

During plan development, public involvement varied according to the intensity with which a stakeholder wished to participate. Primary leadership was provided by an Executive Committee, which in turn, guided the Task Force and provided information to the general public. Public meetings were held throughout the plan development. Task Force meetings were also open to public observation. The meeting dates and locations were sent in news releases to local newspapers. All information was posted on the project website with links from the Chapman Lakes website. A draft plan was available for public comment during the last quarter of the project. Comments were received from the CLCA and CLF representatives and from the LARE reviewers. No comments were received from county or local officials. Additional detail on each of the modes of communication is presented below.

3.1.1 Task force and executive committee

The Chapman Lakes Foundation invited local leaders to participate in the development of a strategic lake management plan (SLMP). The volunteer **strategic planning task force** represented the diverse groups of Chapman Lakes' users and its input is vital to plan development (Table 12). The result of the planning process is a roadmap that benefits the future health of the lakes. The task force provided guidance to D.J. Case & Associates, in the early stages, and J. F. New and Associates, Inc., contractors hired to facilitate and aid in writing the final document, conduct public meetings, and approve all parts of the SLMP. The task force set the pace for plan development.

Task force members have ownership of plan development. There were at least 12 strategic task force meetings and two public meetings to gather input for the plan. The process involved the following considerations. The task force was required to:

- Identify the executive committee and the strategic planning task force
- Develop vision and mission for inclusion in the Strategic Lake Management Plan
- Identify and prioritize issues and concerns for the lake
- Determine whether concerns are a significant problem
- Determine scope of problems
- Identify potential causes of problems
- Determine whether causes are significant

- Gather/obtain data needed to determine causes of problems
- Identify and prioritize potential solutions for causes of problems
- Develop plan goals and quantifiable objectives
- Develop implementation plan of solutions/mitigation efforts. These involve:
    - Technical/physical considerations
    - Political/organizational issues: regulatory, structural and/or financial
    - Social needs: marketing, education, outreach and or other communications
- Identify timeline, resources needed and responsibilities for plan
- Develop and implement final plan

Table 12. List of Executive Committee and Task Force members

Task Force Members	**Title/Organization**	**Position on Executive Committee**
Coral Amspaugh-Topolski	Island Park Prop. Owners Assn.	N/A
Emily Cowan	CLCA member/local resident	N/A
Max Deatsman	Local agricultural producer	N/A
Leonard Draving	CLCA Scientific	N/A
Rich Dunbar	Div. Nature Preserves	N/A
Ed Enders	Local resident	N/A
Mark Ganger	CLCA	Exec. Committee Member (ECM)
John Hall/Greg Hall	Chapman Lakes Foundation	CLF President
Julie Harrold	IN Dept. of Natural Resources	N/A
Dick Kemper	Kosciusko Co. Surveyor	N/A
Kathy Kostro	CLCA Director	N/A
Linda Schmidt	IN Dept. of Environ. Mgmt.	N/A
D.C. Lee	CLCA/CLF	Exec. Committee Member
Bill Magurany	CLCA	Exec. Committee Member
Sgt. Chris McKeand	Kosciusko Sheriff's Dept.	N/A
Steve Parker	Lake Resident, Businessman	N/A
Jed Pearson	IN. Dept. Natural Resources	N/A
Tom Ross, Chairman	CLF/CLCA	President CLCA and ECM
Vere Shenefield	Resident	N/A
Sam St. Clair	Dist. Conservationist	N/A
Robert Stevens	Local agricultural producer	N/A
Lt. John Sullivan	IDNR, Div. Law Enforcement	N/A
Chad Watts	Nature Conservancy	N/A
Howard Woodward, Jr.	CLF	Exec. Committee Member

Two Chapman Lakes Foundation board members and two Chapman Lakes Conservation Association board members made up the **executive committee** and also served on the task force. The executive committee oversaw the contract with both consulting contractors and worked with task force members to improve the plan development process.

The individuals serving on the task force provided a great deal of local insight into the process of watershed planning (Table 12). Without their input, it would have been very difficult to determine which conservation practices and communications tools were feasible for this physical region and social setting.

D.J. Case & Associates, during the early stages, and finally J. F. New and Associates facilitated the gathering of data and information to prepare the Strategic Lake Management Plan. They offered expertise in conservation, public outreach, and education to guide development of the plan.

3.1.2. Public meetings and presentations

Community outreach regarding development of the SLMP included the development and distribution of materials that described the project for the community. Information on the status of the project was provided on the Chapman Lakes website, at meetings and through targeted electronic and surface mail.

The general public had access to the information produced throughout the 18 months of the project, as all meeting minutes and dates were posted on the website. In addition, news releases were sent to local papers, including publication in the *Warsaw Times*. Several Kosciusko County offices and local organizations distributed this information through their newsletters and links on their websites. Presentations were given in person or through handouts to members of the Kosciusko County Soil and Water Conservation District, Kosciusko County Commissioners, and other local organizations.

The first public meeting was held on August 13, 2005, to obtain input on the watershed, water quality, and land use concerns related to the strategic lake management plan. All stakeholders and the general public were invited and encouraged to attend public meetings. All Task Force meetings were also open to the public. A second public meeting was held on October 7th, 2006, to solicit comments on the preliminary draft and discuss implementation. A complete draft plan was distributed to the Task Force for review and comment in November 2006. The draft plan was then posted on the Chapman Lake website for public comment.

3.1.3 Interviews

Over the course of several months (September 2005 through September 2006), project managers interviewed individuals in the area to further develop a sense of community objectives specific to Chapman Lakes and its stakeholders. Input was solicited from community leaders, representatives of stakeholder groups, and others who could provide technical expertise on various land and water management practices. This information was invaluable for identifying progress that has been made since the 2001 diagnostic study and additional efforts that could be recommended for further action.

3.2 Community concerns

At their strategic lakes planning meeting on June 8, 2005, the Task Force discussed concerns with the health of the lake. Over 70 topics were identified, ranging from water quality to boat access. DJ Case compiled the Task Force's concerns and developed a concern prioritization survey for the task force to fill out and rank concerns. These prioritized concerns were presented to the public on August 13, 2005 for additional comment and clarification. Participants at the meeting added several issues, which were folded into the prioritization scheme prepared by the Task Force. Each major category is presented in priority order with subtopics in rank order within the headings; overall ranking of each topic relative to all other 79 topics is also provided (Table 13).

Table 13. Prioritized community concerns as identified by the task force and public in 2005. Priority rankings indicate importance (ranked 1-79) as ranked by watershed stakeholders in August 2005. Low scores (1) indicate higher priority than high scores (79).

Concern	Priority
1. Watershed Management, Erosion Control	**3**
a. Work with landowners to install erosion control (ex. buffer strips)	5
b. Enforcement of erosion control rules (Rule 5) in urban construction	6
c. Long term maintenance of new and existing control measures	7
d. Pinpoint where problems are coming from in watershed	18
e. County not using erosion control in road construction	35
2. Water Quality, Clarity and Depth	**4**
a. Too much accumulated sediment (decreased depth and source of nutrients)	17
b. Impact of nutrients on water clarity	19
c. Eutrophication (need to slow the aging of the lake)	25
d. Excess fertilizers (phosphorus)	26
e. Improper use of herbicides along shoreline and in water	34
3. Septic Systems and Sewers	**12**
a. Have not identified sources and impacts of E. coli in the lake	36
b. If needed, develop a long term plan for sewer installation	45
c. Cost of sewer construction	53
d. Levels of E. coli in the lake are too high	54
e. Conduct a study to determine whether sewers are needed	62
4. Local Control	**14**
a. County disregard for impact of zoning on lakes (county interests differ from lake interests)	1
b. Lake management plan should be considered in development of county land use plans	2
c. Need to develop a common plan and objectives with public officials who administer the public funds used to improve the lake and manage the watershed	11
d. Lake residents concerns need to be heard at zoning meetings	13
e. Move control to local level (permits, zoning, enforcement)	24
f. County commissioners do not attend lake meetings	43

5. Shoreline, Habitat and Dam / Levee Management	**20**
a. Inadequate long term maintenance of dam and levee	27
b. Loss of fish and wildlife habitat	39
c. Proliferation of piers, lifts and structures	51
d. Shoreline attracts development	55
e. Protect natural shorelines and restore degraded areas	63
f. Shoreline alteration reduces attractiveness and habitat	71
6. Community/Stakeholder Involvement and Buy-in to Plan Development	**21**
a. Maintaining organizational structure that will support the implement of plan and program for years to come	8
b. Volunteers needed to implement the plan and program	9
c. Agricultural representation	29
d. Work with adjoining property owners	28
e. Process of plan development	42
f. Broad representation of stakeholders on task force	44
g. Community not buying into plan	49
h. Inadequate coverage of Little Chapman Lake in plan	61
i. Representation of high speed boating interests (ex. skiers)	70
7. Urban Development	**23**
a. Eliminate funneling	10
b. Too many housing additions	33
c. Population explosion (too many people living around the lake)	41
8. Public Expectation and Use of Lake	**31**
a. Public overuse and abuse of lakes	15
b. Public disregard for how their actions effect the lake	16
c. Public's unreasonable or unrealistic expectations (inform and educate)	40
9. Aquatic Plant Management	**32**
a. Control phosphorus to reduce aquatic plant growth	30
b. Excessive aquatic plants	37
c. Cost of aquatic plant control	50
d. Impacts of aquatic plant control	52
e. Loss of emergent bulrush	66
10. Law Enforcement and Compliance	**47**
a. Visitors or weekend boaters are not familiar with watercraft rules	38
b. People who don't know laws do not attend boater education courses	60
c. No spotters while skiing or tubing	67
d. Wakeboarders going over buoys	72
e. Hard to obtain registration numbers of noncompliant boats	73
f. Lozier trailer park residents do not abide by watercraft rules	77

11. Boats and Personal Watercraft	**57**
a. Agitation of nutrients in lake bed by power boating in shallows	22
b. Number of boats on lake	48
c. Fuel contamination from boats	58
d. Boats contaminating the lake	59
e. Noise from jet skis and loud boats	65
12. Nuisance Wildlife, Invasive Species	**68**
a. Geese (affects of hunting, shoreline plants, feces)	46
b. Lack of laws requiring boat cleaning to reduce aquatic nuisance species transfer	56
c. Muskrats undermining seawalls, eroding channels and levee	69
d. Beavers removing trees	74
e. Groundhogs (burrowing)	79
13. Public Access	**76**
a. Too many nonresident boaters	64
b. Lack of parking at public access	75
c. Loss of public access to water	78

4.0 Inventory of current water quality

4.1 State and regional benchmarks for water quality

State and regional reports provide benchmarks for water quality in Indiana lakes and streams by identifying how the watershed fits into the overall state and regional picture.

4.1.1 Previous lake and watershed basin studies

A number of water quality and land use studies have been conducted on the Chapman Lakes and their watershed (Table 14). Data from these studies are summarized in the sections of this plan regarding water quality trends.

Table14. Previous studies that included Chapman Lakes and dates conducted.

Year	Entity	Topic	Study
1964	IDNR, DFW	Fisheries	Lake Survey Report, Big Chapman Lake
1969	IDNR, DFW	Fisheries	Lake Survey Report, Little Chapman Lake
1986	IDEM	Water Quality	IN Lake Classification System and Management Plan
1976	IDNR, DFW	Fisheries	Big Chapman Lake Fisheries Management Report
1976	IDNR, DFW	Fisheries	Little Chapman Lake Fisheries Management Report
1980	IDNR, DFW	Fisheries	Preliminary Investigations of the Chapman Lake Walleye Population
1981	IDNR, DFW	Fisheries	Fishing Pressure and Harvest at Big Chapman Lake
1989	IDNR, DFW	Fisheries	Largemouth Bass Population Size and Exploitation Rate
1989	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment
1991	IDNR, DFW	Fisheries	Big Chapman Lake Fish Population Survey
1994	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment
1998	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment
1999	IDNR, DFW	Fisheries	Big Chapman Lake Fish Management Report
1999	IDNR, DFW	Fisheries	Little Chapman Lake Fish Management Report
1999	IDNR, DFW	Mussels	Natural Lakes Mussel Survey
2000	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment
2001	IDNR, DSC/ JFNew/CLF	Watershed Management	Chapman Lake Diagnostic Study
2001	IDNR, DFW	Fisheries	Northern Pike Spawning Habitat Investigations at Two Natural Lakes
2002	IDNR, DSC/ JFNew/CLF	Watershed Management	Chapman Lakes Engineering Feasibility Study
2003	IDNR, DSC/ JFNew/CLF	Water Quality Improvement	Crooked Creek Design-Build Project
2004	IDNR, DSC/ JFNew/CLF	Water Quality Improvement	Arrowhead Drain Design-Build Project
2004	IDNR, DSC/ JFNew/CLF	In-Lake Management	Aquatic Plant Management Plan for the Chapman Lakes
2004	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment

Year	Entity	Topic	Study
2005	IDNR, DSC/ JFNew, CLCA	Watershed Management	Lozier and Highland Park Drains Engineering Feasibility Study
2005	JFNew - CLCA	In-Lake Management	Aquatic Plant Survey
2006	IDNR, DFW/ JFNew/ CLCA	In-Lake Management	Aquatic Plant Survey and Plant Management Plan Update

CLF=Chapman Lakes Foundation
CLP=Clean Lakes Program
DFW=Division of Fish and Wildlife
DSC=Division of Soil Conservation
IDEM=Indiana Department of Environmental Management
IDNR=Indiana Department of Natural Resources
JFNew=J.F. New & Associates, Inc
CLCA=Chapman Lakes Conservation Association

4.1.2 Statewide impaired waters 303(d) list

The 303(d) list, named after the numbered section in enabling legislation from the federal Clean Water Act, provides a listing of waters that do not or are not expected to meet applicable water quality standards. Designation on the 303(d) list is significant because IDEM Section 319 funds are primarily targeted to these areas.

A common reason for designating Indiana lakes or streams as an “impaired waterway” is because samples collected by IDEM did not meet state water quality standards prepared under the federal Clean Water Act due to *E. coli* contamination, or they did not support a healthy community of fish and aquatic wildlife. (*Escherichia coli,* or *E. coli*, is one of hundreds of strains of bacteria that live in the intestines of healthy humans and animals. High levels may indicate the presence of contaminated water that may cause sickness when ingested.)

Waters in the county that were listed in 2004 for either *E. coli* or impaired biotic communities include Turkey Creek, the Skinner/Hoopingarner Ditches, and the Tippecanoe River, along with lakes Tippecanoe, Sechrist, Oswego, and James. Big and Little Chapman Lakes and the streams in their watershed are not on the 303(d) list. Therefore, any water samples collected by IDEM in the Chapman lakes and their watershed met all state water quality standards prior to development of the 2004 list.

Mercury is a naturally occurring presence as a result of normal breakdown of minerals in the earth's crust. Inorganic mercury enters the air from the burning of coal or garbage and from the emissions of factories that use mercury. Once in water, methyl mercury is very persistent in lakes and streams. Long or short-term exposure to either organic or inorganic mercury can damage the brain, kidney, and developing fetuses.

Like mercury, PCBs remain in aquatic systems long after their introduction. They have excellent electric conductive properties where used industrially as coolants, insulating materials, and lubricants in electrical equipment. The United States stopped making them in 1977 because of a range of potential health effects demonstrated in laboratory animals.

Several other Kosciusko County lakes are listed as impaired waters for either mercury and/or polychlorinated biphenyls (PCBs). Kosciusko County waters that are listed for one or both of these contaminants are Waubee, Wawasee, Center, Tippecanoe, Winona, Little Barbee, Palestine, Webster, Dewart, Barrel and a Half, Spear, and Shock Lakes as well as the Tippecanoe River.

4.1.2.1 CLCA Scientific conducts comprehensive water quality measurements, including bacteria, at multiple sites throughout the year when the lakes are free of ice. A report from their summer of 2005 and 2006 monitoring program along with prior sampling data documentation from 2000 through 2005 is contained within **Appendix A**. The data includes in-lake sampling of both Big and Little Chapman Lakes in addition to in-stream sampling of Lozier's Creek (Lozier Drain), Arrowhead Park Drain, Crooked Creek, Highland Park Drain, and the Outlet-Dam.

Online resources:
IDEM 2004 303(d) list of impaired waters
http://www.in.gov/idem/water/planbr/wqs/303d.html

4.1.3 Fish consumption advisories

A number of Indiana lakes are listed on the 2004 fish consumption advisory for mercury and polychlorinated biphenyls (PCBs) in fish. The ISDH provides information about the sources and effects of these persistent chemicals.

In the state *Fish Consumption Advisory*, Group 1 fish show low to no risk of contamination and consumption is not restricted. Group 2 is recommended at not more than one meal per week. Group 3 is recommended at not more than one meal per month. Fish in Group 5 should not be eaten. Note that advisories may be more restrictive for women who are nursing or intend to become pregnant and for children under the age of 15 years.

In Kosciusko County, there are fish consumption advisories for mercury and/or PCBs in fish tissue for the following lakes: Center, Wawasee, Little Barbee, Palestine, Pike, Tippecanoe, and Winona. There are no specific fish consumption advisories for either Big or Little Chapman Lakes.

Generally, larger carp are contaminated with mercury and PCBs. The following advisory applies to all Indiana rivers and streams unless otherwise noted: over 25 inches (Group 5); 20-25 inches (Group 4); and 15-20 inches (Group 3).

Online resources:
Indiana State Department of Health Fish Consumption Advisories
http://www.ai.org/isdh/programs/environmental/fa_links.htm

4.1.4 Unified Watershed Assessments (UWA)

In partnership with other agencies, the IDEM and Natural Resources Conservation Service (NRCS) led the development of the Unified Watershed Assessment (UWA), a requirement of the Clean Water Action Plan of 1997. Through evaluation of water quality data, natural resource concerns, and human activities that may have the potential to impact water quality, all 11-digit hydrologic unit watersheds in the state were prioritized for restoration work. The UWA characterized the 361 watersheds in the state at the 11-digit level for 15 different parameters. Copies of the UWA are available from the IDEM Watershed Management Section.

The Chapman Lakes watershed was located within the priority areas outlined in the 2001 Unified Watershed Assessment. The priority areas were classified as watersheds in need of financial or technical assistance for maintenance and improvement of water quality.

Online resources:
Map of funding areas for 2001 within the Unified Watershed Assessment.
http://www.in.gov/idem/water/img/prioritywatersheds.jpg

4.1.5 Volunteer water quality monitoring
Residents at Chapman Lakes have been active participants in the volunteer water quality monitoring programs administered by two agencies in the state of Indiana.

Volunteers prepare and send data records to the Volunteer Lake Monitoring program jointly run by Indiana University and the IDEM. Five observations were made in Big Chapman Lake and four in Little Chapman during July-August 2004. Seven transparency measurements occurred in Little Chapman Lake in 2005 with an additional 11 monitoring events occurring in 2006. No volunteer assessments occurred in Big Chapman Lake in 2005, while seven Secchi disk measurements were recorded in 2006. More advanced sampling for chlorophyll *a* and total phosphorus occurred in for Big Chapman Lake in 2004; however, chlorophyll *a* and total phosphorus were not assessed in Little Chapman Lake by volunteers. The CLP did not report any chlorophyll *a* or total phosphorous assessments for Big Chapman Lake for 2005 or 2006. Results and interpretation of these data are presented in sections of the plan on water quality trends.

As indicated in program materials, Hoosier Riverwatch promotes stewardship of Indiana's waterways through a volunteer stream monitoring and water quality education program. Riverwatch is supported by the Indiana Department of Natural Resources, Division of Fish and Wildlife in cooperation with Purdue University. Values stored in the Riverwatch databases result from volunteer monitoring efforts and were not obtained by scientific professionals. Both programs provide quality control training to volunteers and maintain statewide databases of information that can be used to identify areas that merit further professional study to determine more precisely what water quality problems may exist and their potential sources.

Area residents participated in the IDNR Riverwatch program in the late 1990s. A search for data from the Tippecanoe 05120106 watershed resulted in several sets of chemical data from 1996-1998 which are available in the Hoosier Riverwatch database for a site on the south side of CR 175N at Heeter Ditch and for a number of locations along Deeds Creek, which are both downstream of Chapman Lakes. No biological or habitat conditions were recorded for these streams. No data was recorded for any streams in the Chapman Lakes watershed.

In 2005, the Chapman Lakes Conservation Association (CLCA) initiated an ongoing project when the governing board of directors agreed to purchase equipment and fund a water sampling project (as previously outlined above) for the next three years at an initial cost of $3,000. The project coordinator will enlist volunteers to assist with sampling. Over 50 water quality tests are anticipated in the Chapman Lakes system throughout the year when the lakes are free of ice.

Online resources:
Indiana Volunteer Lake Monitoring program
http://www.spea.indiana.edu/clp/Volunter%20Monitoring.htm

Hoosier Riverwatch
http://www.in.gov/dnr/soilcons/riverwatch/

4.2 Water Quality

4.2.1 Previously documented water quality

Indiana Lakes Clean Water Quality Assessments of Little and Big Chapman Lakes dated 1989, 1994, 1998, 2000 and 2004 and Biotic Assessments of Crooked Creek, Arrowhead Drain, Lozier Drain, and Highland Park Drain may be found in **Appendix B**. Additionally, data collected by CLCA Scientific in 2005 and 2006 are included in **Appendix B**.

4.2.2 Water quality problems present-day

Little Chapman Lake

- Based on data collected by the IDNR Division of Fish and Wildlife and the Indiana Clean Lake Program, Secchi disk transparency indicates a general decline in water quality from 1973 to 2004. Transparency declined from 7 feet in 1973 to just 2.3 feet in 2004. Transparency measurements recorded during the 2005 aquatic plant survey indicate a slight improvement in transparency (3 feet). Volunteer data collected in 2005 and 2006 indicate that transparency ranges from 1.5 to 3 feet. None of these change are statistically significant.

- Likewise, the 1% light level, the level at which only 1% of surface light penetrates, declined from 1989 to 2004. The 1% light level recorded in 2004 is nearly half that recorded in 1989. This is the lowest value recorded in the history of water quality sampling in Little Chapman Lake.

- The surface water's (epilimnion) pH was typically elevated over the past 30 years of sampling ranging from 8.6 to 8.7 units. Elevated pH levels typically indicate the presence of blue-green algae.

- Plankton concentrations support the elevated pH levels. Plankton increased in density from 1989 to 1998 (1,150/Liter to 52,715/Liter, respectively), but were relatively low during the 2000 assessment (4,231/Liter). However, plankton densities were the highest recorded at Little Chapman Lake during the 2004 assessment measuring 99,881/Liter.

- Chlorophyll *a* concentrations follow a similar trend as that indicated by declining Secchi disk transparency and increasing plankton densities. Chlorophyll *a* concentrations generally increased from 1989 to 1994 (1.8 mg/L to 15.13 mg/L) before declining to 6.56 mg/L in 2000. However, chlorophyll *a* concentrations recorded in 2004 were nearly double the highest concentration previously recorded measuring 33.2 mg/L.

- Little Chapman Lake's water column is typically well oxygenated allowing the lake to support a biotic community. Generally, 33-80% of Little Chapman Lake's water column contains sufficient oxygen (>1 mg/L) to support aquatic biota. However, in 2004, the lowest oxygen levels recorded occurred within Little Chapman Lake; only 17% of the water column contained sufficient oxygen.

- Based on the above information, water quality data indicate that an algal bloom was likely occurring in Little Chapman Lake during the 2004 Clean Lakes Program assessment. The highest plankton density, lowest percentage of water column that is well oxygenated, lowest 1% light level, and highest chlorophyll *a* concentration recorded occurred during this assessment. This would seem to indicate that water quality is declining in Little Chapman Lake; however, a closer look at the nutrient concentrations will likely provide more insight into what is actually occurring within the lake.

- Total phosphorus concentrations generally declined within Little Chapman Lake from 1989 to 1998 (0.215 mg/L to 0.135 mg/L). Concentrations remained low in 2000 (0.148 mg/L) and declined even further in the 2004 assessment (0.095 mg/L) to the lowest level recorded in Little Chapman Lake in the past 30 years.

- Historically, the hypolimnion (bottom waters) possessed higher total phosphorus concentrations. This typically indicates that phosphorus is being released from the lake's sediment. However, in 2004, Little Chapman Lake's epilimnion (surface waters) contained higher total phosphorus concentrations, which suggests that a majority of lake's phosphorus is contained within the lake's plankton population.

- The soluble reactive phosphorus concentration in Little Chapman Lake's epilimnion was below the detection limit during all of the Clean Lakes Program assessments. This is typical in lakes since SRP is readily consumed by algae in the lake's epilimnion. The SRP concentrations in Little Chapman Lake's hypolimnion were typically high over the period of data collection. The data indicate that typically most of the total phosphorus concentration in the lake's hypolimnion consists of soluble reactive phosphorus. This dominance of the dissolved form of phosphorus coupled with the lack of oxygen in the deep waters over the bottom sediments suggests that dissolved phosphorus is being released from the lake's bottom sediments. This is called ***internal phosphorus loading*** and can be a significant additional source of phosphorus in some lakes. The same holds true for the 2004 assessment; however, like total phosphorus, soluble reactive phosphorus concentrations were lower in 2004 than in previous assessments.

- Ammonia-nitrogen concentrations within Little Chapman Lake were also typically higher in the hypolimnion than in the epilimnion. The decomposition of organic matter likely occurring in Little Chapman Lake's hypolimnion contributes to the elevated ammonia concentrations typically observed in the lake's hypolimnion. Unlike the total phosphorus concentration, ammonia concentrations, particularly the hypolimnetic concentration, has varied over time, but shows no observable trend for either increasing or decreasing over time.

- The lake's Indiana Trophic State Index (ITSI) score reflects the higher density plankton community observed in Little Chapman Lake in 2004. Little Chapman Lake's ITSI did not change from 1973 to 1994, but declined from 1994 to 1998. The change was greater than 10 points, which typically indicates a change in trophic status. However, the ITSI increased from 1998 to 2004 when the highest ITSI score ever recorded occurred. The difference in ITSI scores can mainly be attributed to the difference in plankton density. The ITSI relies strongly on the algal population for score computation. Plankton density within the 2004 sample collected from Little Chapman Lake accounts for nearly 25 of the ITSI points.

- Based on ITSI scores, Little Chapman Lake rated as mesotrophic during the 1989 and 1994 assessments, eutrophic during the 1998 and 2000 assessments, and now rates as hypereutrophic based on the 2004 assessment. Carlson's Trophic State Index provides a little more insight into Little Chapman Lake's water quality. Based on Secchi disk transparency, Little Chapman Lake rated as mesotrophic (1989), increased to a eutrophic rating (1994, 1998, and 2000), and rated as eutrophic to hypereutrophic in 2004. The chlorophyll *a* concentration presents similar results with the lake rating as eutrophic in the 1994, 1998, and 2004 assessments and mesotrophic in the 2000 assessment. Little Chapman Lake rated as hypereutrophic for total phosphorus during each of the five assessments.

Big Chapman Lake

- Like Little Chapman Lake, Big Chapman Lake's Secchi disk transparency indicates a general decline in water quality since 1964. Transparency data collected by the Indiana Clean Lakes Program and the Indiana Department of Natural Resources indicates that water quality in Big Chapman Lake changed little from 1964 to 1999 with transparency readings fluctuating between 8.9 feet and 12 feet. However, transparencies recorded in 2000 and 2004 (7.6 and 7.2 feet, respectively) were the lowest recorded in Big Chapman Lake.

- Volunteer monitoring data suggests similar results as those observed by the Indiana CLP and IDNR with median transparency values fluctuating from 3.5 feet to 10 feet from 1989 to 2006. There is no apparent trend in volunteer-collected Secchi disk transparencies.

- The 1% light level fluctuated somewhat over time. Measurements ranged from a high of 23.5 feet in 2000 to a low of 17.4 feet in 2004. In general, this indicates that light penetration has changed little over time.

- Plankton concentrations also fluctuated over time with the highest density recorded during the 1998 assessment (17,570/Liter). The lowest density was recorded during the 2000 assessment (2,203/Liter). Of concern is the increase in blue-green algal dominance over the past 16 years. During the 1994 and 1998 assessments, blue-green algae accounted for 16% to 32% of the algal population; however, blue-green algae accounted for 67% and 82% of the 2000 and 2004 populations, respectively.

- Chlorophyll *a* concentrations were typically low in Big Chapman Lake ranging from a low of 1.7 mg/L in 2000 to a high of 3.3 mg/L in 2004. Concentrations like these are typically present in relatively unproductive lakes.

- Typically, more than half of Big Chapman Lake's water column contains sufficient oxygen levels to support biota. During both Indiana CLP and IDNR assessments, Big Chapman Lake possessed sufficient oxygen in 45% to 82% of its water column.

- Total phosphorus concentrations are typically low in Big Chapman Lake. Total phosphorus concentrations generally increased from levels observed in 1994 and 1998 (0.035 mg/L and 0.020 mg/L, respectively) to levels observed in 2000 and 2004 (0.056 mg/L and 0.048 mg/L, respectively); concentrations observed during the second period of time are nearly double those observed during the first period of time. The lake's hypolimnion typically possesses higher total phosphorus concentrations than the lake's epilimnion. This suggests that phosphorus may be released from the lake's sediment into the water column.

- Like total phosphorus, ammonia-nitrogen concentrations present in Big Chapman Lake's hypolimnion are greater than those observed in the epilimnion. The decomposition of organic matter likely occurring in Big Chapman Lake's hypolimnion contributes to the elevated ammonia concentrations typically observed in the lake's hypolimnion.

- The lake's Indiana Trophic State Index (ITSI) score reflects the predominance of blue-green algae in Big Chapman Lake in 2000 and 2004. Big Chapman Lake's ITSI was extremely low during the 1994 and 1998 assessments; the lake scored 5 and 7 points, respectively. However, ITSI scores observed in 2000 and 2004 (20) reflects the 10 additional points the lake receives for possessing a plankton community dominated by blue-green algae.

- Based on ITSI scores, Big Chapman Lake rated as oligotrophic during the 1994 and 1998 assessments mesotrophic during the 2000 and 2004 assessments. Carlson's Trophic State Index provides a little more insight into Big Chapman Lake's water quality. Based on Secchi disk transparency, Big Chapman Lake rated as mesotrophic for all four assessments. The chlorophyll *a* concentration presents similar results with the lake rating as mesotrophic during all assessments. Big Chapman Lake rated as mesotrophic to eutrophic for total phosphorus during the 1994 assessment, mesotrophic during the 1998 assessment, and eutrophic during the 2000 and 2004 assessments.

Chapman Lake Tributaries

- JFNew assessed the habitat and biotic communities present within the lakes' tributaries on two separate occasions. Crooked Creek and Arrowhead Drain were assessed during completion of the 2002 Chapman Lakes Feasibility, while Highland Drain and Lozier Drain (Bixler and Gilliam Drains) were assessed during completion of the current Highland/Lozier Drain Feasibility study.

- The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of stream segments in Ohio have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas. Scores greater than 75 typify habitat conditions that have the ability to support exceptional warmwater faunas (Ohio EPA, 1999).

- Crooked Creek provides the best habitat of any of the five tributary streams scoring 78 of a possible 100 points. As described above, Crooked Creek likely supports exceptional warmwater biotic communities. Highland Drain provides the poorest habitat scoring only 24 of 100 possible points. In general, Highland Drain lacks pool-riffle complex development and possesses poor substrate, channel development, and in-stream cover. Scores for the two branches of Lozier Drain and for Arrowhead Drain ranged from 45 to 54 points. In general, the streams possessed poor substrate, lacked in-stream cover and channel morphology, and contained limited pool-riffle sequences.

- Crooked Creek's Index of Biotic Integrity (fish) indicates that the fish community of Crooked Creek in the "good" integrity class. The only metric to receive a poor score was the percent tolerant individuals metric indicating that the majority of individuals collected in the stream were pollution tolerant. Other metrics received average or good ratings. Due to watershed activities and non-point source pollution, it is unlikely that sensitive species can survive in Crooked Creek. These factors are probably also responsible for the low number of species (four) identified from the stream.

- The IBI score calculated for the fish community of Arrowhead Drain in the "fair" integrity class. The metrics that received poor scores were the percent omnivore individuals, percent insectivore individuals, percent lithophilous individuals, and percent DELT individual metrics. The IBI requires that these metrics score poorly if fewer than fifty individual fish are collected during sampling. Other metrics received average or good ratings. Due to watershed activities and non-point source pollution, it is unlikely that sensitive species can survive in Arrowhead Drain. These factors are probably also responsible for the low number of species (five) identified from the stream.

- As Highland Drain did not contain any water at the time of the macroinvertebrate assessment, no assessment could actually occur.

- However, both branches of Lozier Drain were assessed. In general, the macroinvertebrate communities rated as severely impaired scoring a macroinvertebrate Index of Biotic Integrity score of 0.6 to 0.8 points (8 total). The limited number of individuals and families and predominance of tolerant families characterized the biological communities present in W. Bixler and W. Gilliam Drains. Due to watershed and non-point source pollution, it is unlikely that intolerant species can survive in either branch of Lozier Drain.

5.0 Inventory of current practices, water quality impacts and potential actions

The following paragraphs detail practices that occurred in the watershed at the time of plan development. Issues, concerns, and current assessments were developed from available information including the 2001 diagnostic study and subsequent watershed feasibility studies. Sources for each section are detailed below. Potential actions for each issue or area of concern are also included where appropriate and possible.

5.1 Watershed management and erosion control

Erosion control is critical for lake water quality in both agricultural and urbanizing areas. Agricultural land accounts for approximately 89% and 85% of the land in the Lozier's Creek and Crooked Creek subwatersheds, respectively. Agricultural land accounts for only 43% of the land draining directly to the lakes. By 1964, nearly 90% of the Big Chapman Lake shoreline was developed (McGinty, 1964). In 1976, nearly 50% of the Little Chapman Lake was developed with 121 homes (Shipman, 1976). The resident survey indicated that 75% of the respondents had remodeled their house in the past 20 years. In some cases, cottages were razed and replaced with newer residences in which property owners lived fulltime rather than seasonally.

The 2001 *Diagnostic Study* provided a basis for identifying and mapping areas with critical soil and water conservation needs. Identification and mapping of problem areas should continue on a regular basis to stay current with a changing landscape.

Potential Action:

- Conduct routine periodic inventory and mapping of areas with critical conservation needs around Chapman Lakes and in the watershed.
- Use inventory information to update and target strategic lakes management actions in areas where efforts will be most effective.

Online resources:
2002 Indiana Soil Loss Data Map
http://www.agry.purdue.edu/swq/images/soillossmap.pdf

5.1.1 Fertilizers in crop production

According to data from the office of the Indiana State Chemist there were 37,650 tons of fertilizer and plant nutrients applied in Kosciusko County in 2004 with nearly three-quarters of the nutrients applied in the first half of the year (Table 15). Fertilizer use was somewhat greater than in Marshall County. The total tonnage of fertilizers applied was 2.5 times greater in Kosciusko County than in Noble County. The amount of fertilizer used is directly related to crop acreage and yields in these counties. The acreage of cropland is appreciably greater in Kosciusko County (225,000 acres) than the other two counties (Noble: 146,000 acres; Marshall: 168,000 acres). Average yields in Kosciusko County are also higher than Noble, and this would account for more fertilizer application.

Table 15. Fertilizer and nutrients (tonnage) applied by county in 2004.

Date	County	Total fertilizer	Total N	Total P_20_5	Total K_20
January-June 2004	Kosciusko	28,198	6,182	1,644	3,549
	Marshall	20,787	7,160	1,600	3,236
	Noble	10,528	1,734	1,057	2,363
June-December 2004	Kosciusko	9,452	1,138	828	2,519
	Marshall	4,403	447	428	1,522
	Noble	3,597	470	351	876
2004 Total	Kosciusko	37,650	7,320	2,472	6,068
	Marshall	25,190	7,607	2,028	4,758
	Noble	14,125	2,204	1,408	3,239

Potential Actions:

- Follow dosing recommendations on product labels.
- Test soils to determine fertilizer needs.
- Encourage farmers in the watershed to develop Nutrient and Pest Management Plans with assistance from the USDA NRCS. Incentive payments to develop these plans may be available from the environmental Quality Incentive Program (EQIP) administered by NRCS.

Online resources:
Fertilizer and Nutrients by County, Indiana Fertilizer Tonnage data from:
http://www.isco.purdue.edu/fert/2004_Total_fert_and_Nutrients_by_County.pdf

5.1.2 Pesticides and herbicides in crop production

Pesticide and herbicide use in agricultural areas has changed dramatically over the past decade with introduction of new or improved chemicals, genetically modified crops, and computerized mapping of weed infestations in fields. Modern chemicals are formulated to increase their effectiveness while reducing environmental impacts. All chemicals used on farms are regulated by the U.S. Environmental Protection Agency and must be applied according to rates and uses stipulated on the chemical label. Several chemicals that were used in the past to control pests and weeds are no longer used due to persistent toxicity. Soybean growers and pesticide applicators will be looking for signs of soybean rust during the 2006 season and in future years.

Indiana maps of Federally Endangered Species do not indicate any areas within Kosciusko County that support federally listed bird species, but there are federally listed mussel species that could be negatively affected by improper use of soybean rust fungicides. Prime mussel habitat is prevalent throughout the Tippecanoe River in northern Indiana.

Potential Actions:

- Follow dosing recommendations on product labels.
- Monitor crops to determine pesticide needs.
- Encourage farmers in the watershed to develop Nutrient and Pest Management Plans with assistance from the USDA NRCS. Incentive payments to develop these plans may be available from the environmental Quality Incentive Program (EQIP) administered by NRCS.

Online resources:
Soybean Rust Fungicides and the Possible Impact on Federally Endangered Species
http://www.isco.purdue.edu/pesticide/soybean_rust_fungicides_impact.html

5.1.3 Tillage practices

Corn, soybeans, and tomatoes are the major crops grown on agricultural land in the Chapman Lakes watershed. Although exact percentages of each crop were not recorded for the watershed, approximately 49% of the cropland in Kosciusko County was planted in corn and 39% in soybeans in 1998. It is likely that the Chapman watershed closely mirrors these percentages.

For the most part, use of conservation tillage is increasing in Kosciusko County. In 2005, no till corn covered 21% of total acreage with mulch till on 14%. No till was used on 74% of soybean acres with mulch till on 13%. In comparison with 1998, no-till was practiced on approximately 17% of the farmland planted in corn. Mulch tillage (a tillage method that leaves at least 30% of residue cover on the surface after planting) was practiced on approximately 13% of the farmland planted in corn. For fields planted in soybeans, the percentage of farmland utilizing conservation tillage methods was higher: 57% in no-till, 25% in mulch-till.

Lozier's Creek subwatershed contains the greatest amount of highly erodible soil units of all the subwatersheds and nearly half of the subwatershed (140 acres) is mapped in potentially highly erodible soil units (Table 8). Note: Crooked Creek's watershed has more *potentially* highly erodible acreage by percentage of the drainage area; however, Lozier's Creek watershed has more potentially erodible and highly erodible acres overall.

Potential Actions:

- Establish buffer strips and grassed waterways, particularly in the headwaters of the Crooked Creek and Lozier's Creek subwatershed where most of the HEL exists.
- Encourage farmers in the watershed to abandon the practice of fall tillage of soybean stubble. Instead the corn can be no till planted into the soybean stubble. Incentive payments for this practice may be available through the USDA EQIP program administered by NRCS.

5.1.4 Conservation buffers

The 2001 Diagnostic study suggested that one way to reduce nutrient and sediment runoff associated with agricultural practices would be to remove land from agricultural production. Farmers receive cost share assistance for the plantings and annual payments for their land through the Conservation Reserve Program (CRP).

Potential Actions:

- Form a partnership with agricultural property owners who currently utilize conservation methods to sponsor educational forums to educate other agricultural property owners on how conservation methods work and their impact on the Chapman Lakes.
- Place sensitive land in CRP, particularly areas that are highly erodible, riparian zones, and farmed wetlands.
- Establish a grassed waterway in the agricultural land at the headwaters of Crooked Creek, north of CR 300 North and east of Country Road 400 East
- Maintain the grassed waterway at the headwaters of the Arrowhead Park drainage.

5.1.5 Residential use of fertilizers, pesticides and herbicides

Many of the shoreline residences on the lakes have maintained turf grass lawns behind concrete seawalls. Fertilizers, pesticides, and herbicides for lawns and gardens are a potential source of nutrients and toxins to the lakes. Restoring native plantings along shorelines instead of manicured turf grass can provide fish and wildlife habitat, enhance shoreline erosion control, filter runoff to the lakes, discourage nuisance geese, and enhance the natural character of the lake (see also Section 5.5 Shoreline, habitat and dam management; Section 5.7 Aquatic plant management).

Potential Actions:

- Follow dosing recommendations on product labels.
- Test soils to determine fertilizer needs.
- Do not dispose of grass clippings and leaves in the lake.
- Do not fertilize near driveways and streets where fertilizer can wash directly into the lake.
- Where aquatic plants are controlled remove dead plant material from the lake if practical.
- Use lawn and garden fertilizers containing no phosphorus.
- Maintain natural landscapes with plants that do not require fertilizers or pesticides.
- Replace high maintenance turf grasses with shrubs, flowering plants and ornamental grasses.
- Beware of high phosphorus products like Miracle Grow.
- Establish, maintain, and publish a list of preferred providers for lawn chemical applicators who use phosphorus free fertilizer, such as the list at http://www.chapmanlake.com.

5.1.6 Erosion control

In 2001, Crooked Creek's total suspended solids loading rate was an order of magnitude more than that observed for Lozier's Creek despite the fact that the Crooked Creek subwatershed is slightly (50 acres or 20 ha) smaller than the Lozier's Creek subwatershed. The Crooked Creek subwatershed also possesses the greatest percentage of *potentially* highly erodible land (50%).

An *Engineering Feasibility Study* was completed for Chapman Lakes in December 2002. The purpose of the study was to analyze potential pollution control projects identified in the diagnostic study and determine the feasibility of proposed project construction. The first study pursued the feasibility of three projects within the Chapman Lakes Watershed: bank and channel stabilization of Crooked Creek at Big Chapman Lake, bank and channel stabilization of Arrowhead Drain at Little Chapman Lake, and retrofitting of storm drains that conduct runoff to Big Chapman Lake. A second *Engineering Feasibility Study* was completed for the Chapman Lakes in 2006 focusing on the watershed drainages to Little Chapman Lake including Highland Drain and Lozier Drain. In total, more than 10 projects were studied and prepared for final design or construction.

A 1,530 foot reach of Crooked Creek embankments and a tributary gully were stabilized using bioengineering methods in 2003. The methods included installation of biologs, modified cribwalls, woody debris placement, rock toe, and check dams. Remaining work in the Crooked Creek watershed includes stabilization at the upper end in an existing agricultural field. Approximately 900 feet of the Arrowhead Drain was stabilized in 2004 with check dams and modified soil wraps using existing logs or rocks to stabilize the toe of slope below the turf-reinforcement mat soil lifts. The identified storm drain rehabilitation projects were never implemented. A project to stabilize Highland Drain was funded in 2006 and is proposed for construction in 2007. A proposed project on Lozier Drain has not yet been funded but is being pursued.

Potential Actions:

- Implement all projects deemed feasible in the Feasibility studies described above.
- Monitor implemented projects with annual inspections and water quality data collection.
- Pursue project feasibility and implementation of new erosion sources identified.

5.1.7 Construction sites

Because the watershed is relatively small compared to the lake surface area and shoreline development, land management immediately adjacent to the lake can have major impacts on water quality. Careful design, construction, and maintenance of stormwater control features is critical for protecting the lakes.

Potential Actions:

- Work with the County to enforce erosion control ordinances and state law.
- Reward builders who comply with the intent as well as the letter of the law by supporting their projects.

5.1.8 Impervious areas and stormwater management

A change in land use from forest or open field to low to medium-density residential can result in an increase in the amount of impervious surface. Zoning regulations often require retention of water on site such that there is no or little increase in peak flow from pre-development levels. This is of particular concern along Crooked Creek and Lozier Drain, as these waterways delivers the greatest volume of water (and potential suspended solids) to the lakes.

Potential Actions:

- Limit the amount and impacts of impervious surface in developments, through design features such as:
    - Roadways as narrow as safety allows.
    - Porous surfaces should be considered for driveways and other hard surfaces.
    - Grassed road shoulders should replace curb and gutter systems.
    - Stormwater conduits should be disconnected where possible.
    - Roof gutters should not channel water directly to storm drains.
    - Install filtration trenches, sand filters, and wetlands to treat the first flush of phosphorus and suspended solids that enters detention basins.

  - Investigate drainage pathways for local drains, roads, parking areas, driveways, and rooftops; slow or divert water through French drains (gravel filled trenches), wetland filters, catch basins, and native plant overland swales.
  - Install and maintain roadside swales, drop catch basins or retrofit sand filters on larger drains that lead directly to the lake.
  - Use cluster housing plans and other conservation designs to reduce the amount of impervious surface in a residential development.
- Retrofit nine existing storm drains that lead to Big Chapman Lake using a combination of local funding and federal grants available through county governments like IDEM 205(j) or 319 grants at an estimated cost of $46,100-$52,100. Actions could include:
  - For two drains along Gunter Road (Drains 1 and 2):
    - Schedule and conduct regular maintenance for existing catch basins on the drain inlets.
    - Educate area residents regarding the drainage system and effects of discharging pollutants to these drains.
    - Construct treatment swales in conjunction with rebuilding of the road.
  - For Drain 3 along C.R. 250 East, report violations to the County Health Department and identify a funding source to rebuild the section of pipe and repair the leach field.
  - Monitor Drain 4 at C.R. 400 North and be prepared to address sedimentation, if it appears to worsen.
  - For Drain 5 northeast of C.R. 400 North, create a detention area to slow water delivery to the tile by installing a perforated riser pipe and replacement of the tile on the private property with larger diameter plastic drainage pipe.
  - For Drain 6 south of C.R. 400 North, rebuild the structure with a functioning catch basin and pretreatment infiltration swales when the county repaves Chapman Lake Drive.
  - For Drain 7 north of Crooked Creek, create roadside infiltration trenches and installing a rain garden infiltration system at the inlet.
  - For Drain 8 near the public boat ramp and Drain 9 at the southwest corner of C.R. 325 East, construct a small wetland treatment basin that is conceptually designed to treat nutrients, hydrocarbons, and sediment. (Note: Drains 8 and 9 were improved by Kosciusko County in summer 2005. The drains were enlarged to move storm water more rapidly to the lake. No provisions were made with respect to pollutants flowing into the lake.)

5.1.9 Livestock production

The 2001 diagnostic study did not indicate any significant livestock production in the Chapman Lakes watershed (only one pasture with horses was noted). Since that time, no livestock productions have been noted within the watershed. However, the below action items are included in case that livestock production becomes an issue later.

Potential Actions: (if livestock operations increase in the future)

- Encourage the property owner to follow USDA recommendations.
- Encourage landowners to properly store and manage manure through use of federal Farm Bill funds, watershed land treatment funds through Lake and River Enhancement, and other funding sources.
- Fence livestock away from streams, allow limited access for watering or provide off-stream watering facilities.

- Encourage landowners to maintain and increase livestock management systems for water quality protection through use of federal Farm Bill funds, watershed land treatment funds through Lake and River Enhancement, and other funding sources.

5.1.10 Wetland and stream protection

Most of the watershed's wetlands are located along the western edge of the lakes. A review of aerial photographs in the 2001 study suggested that large portions of the Chapman Lakes shorelines were originally wetland habitat. These wetlands were filled to support lakeshore houses. Only about 49% of the original wetland acreage exists today. The most significant natural wetland is located on the west and south end of Little Chapman Lake, which is owned and protected by the IDNR. Protecting remaining wetlands and restoring drained wetlands are important to the health of the lake.

Based on an analysis of hydric soil in the subwatershed, Crooked Creek suffered the second greatest loss in wetland acreage compared to other subwatersheds (Table 10). This loss of wetland acreage has decreased the storage capacity of the land and increased peak flows of water in Crooked Creek. A decrease in peak flows would reduce erosion from the streambed and channel banks and ultimately reduce sediment loads to the lakes. The general locations and extents of four floodplain wetlands in the Crooked Creek floodplain were mapped during a field survey on April 26, 2002. All wetlands within the bank stabilization project area were described in the 2002 *Engineering Feasibility Study* as high quality, seep-fed wetlands meriting protection and preservation.

Wetlands, although degraded by channel incision or past drainage practices, are located adjacent to Lozier drain just upstream from Chapman Lake drive, and at the southwest corner of 400 East and 200 North (JFNew Engineering Feasibility Study, 2006). Additional wetland acreage (up to 40 acres) could be restored along the Lozier Drain.

A drained wetland that has significant possibilities for restoration or excavation as a stormwater pond lies just west of 325 East Road and south of the CLCA clubhouse. Approximately 1-2 acres could be restored at this location.

Potential Actions:

- Protect wetlands in the Crooked Creek watershed.
- Restore wetlands in the headwaters of Lozier's Creek (William Gilliam Drain).
- Enhance wetlands along the Lozier's Creek immediately east of CR 300 East and ¼ mile north of 200 East.
- Construct a stormwater basin or wetland off 325 East in Arrowhead Drain watershed.

5.1.11 In-stream remediation and In-stream cover

Fish and other aquatic animals are highly dependent on structure in aquatic systems. For example, fish use boulders, root wads, fallen logs, and undercut banks as refuge from temperature extreme and predators. These structures, along with gravel beds and other substrates, are important for nesting and nursery areas, depending on the species. In-stream remediation would improve habitat, which may be a limiting factor in impairment of biological communities and failure to meet state water quality standards. Habitat characteristics include riparian vegetation, stream bank shape, bed materials, depth, erosion, and deposition of sediment.

Potential Actions:

- Install riffle-pool complex to stabilize bed and banks while providing permanent water for fish and macroinvertebrates.
- Leave existing woody debris in stream or install cover as part of new projects.
- Encourage landowners to maintain and increase development of in-stream cover through use of watershed land treatment funds through Lake and River Enhancement and other funding sources.
- Conduct logjam removal projects only where necessary to prevent unacceptable bank erosion or impaired flows.

5.1.12 Riparian corridors

Land use of the corridor adjacent to and along the entire length of stream plays a direct role in the quality of the water and the organisms that inhabit a stream. A wide forested or grassed corridor adjacent to streams will improve both water quality and habitat. Several lakeshore property owners purchased 35 acres of agricultural land north of Crooked Creek with the intention of developing it as wildlife habitat. Another lakeshore owner group has purchased agricultural land in the Highland Drain subwatershed. Both these groups could help play a significant role in improving the water quality entering Chapman Lakes through these streams by being good stewards of the land. Other properties may become available along the major drainages to Chapman lakes and these should be sought out for restoration and long-term protection.

Potential Actions:

- Encourage landowners to maintain and increase development of riparian corridors through use of federal Farm Bill funds, watershed land treatment funds through Lake and River Enhancement, and other funding sources.
- Consider foundation purchase and restoration of lands adjacent to streams.
- Encourage other Chapman Lake property owners to purchase and protect drainage corridors.

5.2 Water Quality, Clarity and Depth

External sources of sediment and nutrients, as well as internal recycling of these materials once they reach the lake affect water quality, clarity, and depth. In addition to preventing these materials from entering the lake, there are a few actions that can be taken to prevent resuspension and availability of these materials by avoiding disturbance, capping, or removing them. Water quality and clarity are driven by the amount of suspended particulate matter in the water column, usually algae or fine sediments (clay). The algae population in the Chapman Lakes is controlled by the amount of available (dissolved) phosphorus. The 2001 Diagnostic Study used the Vollenweider model to demonstrate that approximately 22% of the total phosphorus load to Big Chapman Lake is likely to originate from internal sources. In Little Chapman Lake, internal loading accounts for approximately 37% of the total load. Water depth is affected by sediment that settles on the bottom or by the dam and levee that holds the water level at its legally established elevation (except in draughts when the watershed does not deliver enough water to hold the elevation at the level of the spillway).

5.2.1 Alum treatment

According to the 2001 Diagnostic Study, aluminum salts can be applied to a lake to form a floc or an agglomeration of small particles. This floc (e.g. $Al(OH)_3$) acts in two ways: (a) it absorbs phosphorus from the water column as it settles, and (b) it seals the bottom sediments if a thick enough layer has been deposited. The treatment's expected length of effectiveness should always be weighed against its cost. Costs vary depending upon the location and size of lake, type of applicator barge utilized for treatment, and other factors. Cooke et al. (1993) reported a cost of approximately $1,600 per acre ($640/ha) using a newer (faster) barge applicator. To date, Shakamak Lake, a reservoir in southern Indiana, is the only known large water body to which alum has been applied for water quality enhancement within the state of Indiana.

Potential Action:

- Explore the potential efficiency and cost of an alum treatment, after watershed sources and aquatic plant growth have been controlled and after any desired dredging has been completed.

5.2.2 Lakeshore and channel depth

A sediment survey conducted in conjunction with the 2001 study and again 2006 documented an approximate 0.33 acre (0.13 ha) sediment plume at the mouth of Crooked Creek, 1.4 acres (0.57 ha) of unconsolidated sediment at the mouth of Arrowhead Park Drain (including accumulation at the mouth of the adjacent channel) and approximately 0.33 acre (0.13 ha) of unconsolidated sediment at the mouth of Highlands Park Drain. The average depth of sediment at the mouth of Crooked Creek was 1.75 feet (0.53 m), while Arrowhead Park Drain sediment averaged 3 feet (1.0 m). Less sediment deposition was observed at the mouth of the Highlands Park Drain where unconsolidated sediments averaged a depth of 1.5 feet (0.5 m). The channel between Big Chapman and Little Chapman Lake and the channel at the outlet of Lozier Drain was measured for sediment accumulation and found to contain 6-12 inches (<0.4 ha) of unconsolidated sediment. Additional areas measured for sediment accumulation included the channel at Waw-Wil-A-Way which had an average accumulation of approximately 3 feet (1 m).

Potential Actions:

- Control sources of erosion and sedimentation in the watersheds as well as overabundant aquatic plant growth along the lakeshore.
- Harvest and remove growth of invasive exotic aquatic plants along residential lakeshores, leaving native plants for fish and wildlife habitat. Eurasian water milfoil should not be "harvested" due to its tendency to spread from fragments.
- Dredge those areas of accumulated sediment.

5.2.2.1 Dredging

Dredging can be a viable means of restoring lake depth in areas where historical sources of sedimentation are under control. The feasibility of lake bed dredging depends upon the aerial extent of material to be dredged, the volume of material to be dredged, potential impacts to fish and benthic organisms, cost, and availability of appropriate spoil deposition areas. Dredging can be accomplished by hydraulically removing the sediment with a cutter head and suction pumps or by mechanical excavation from land or barge.

All dredging operations require permits through the IDNR Division of Water with reviews from the IDNR Division of Fish and Wildlife. Permits are also required from the IDEM and U.S. Army Corps of Engineers for return water from sediment disposal basins. None of these agencies look favorably on mechanical dredging due to its greater disturbance in the water column. The LARE program may grant a lake association up to 75 percent of the cost of dredging accumulated sediments if ongoing sources of sedimentation have been addressed. The Chapman Lakes Foundation submitted an application in 2006 for funding to remove sediment at the mouths of Crooked Creek, Arrowhead Park Drain, and the Highland Park Drain seeking funding for a project totaling more than $130,000. The application was denied due to a delay in completing the required dredge plan discussed above.

Potential Actions:
- Apply for another LARE grant in December 2006 based on a completed dredge plan.
- Implement the dredging project in 2007 or 2008 as funding allows.

5.2.3 Septic Systems, Sewers and Animal Waste

Generally, indications of fecal coliform contamination within the Chapman Lakes streams were well within the typical range observed in Indiana waterways, as reported in the 2001 study with the exception of Arrowhead Drain.The 2001 study showed a particularly elevated *E. coli* concentration in Arrowhead Park Drain at base flow conditions. The count of 8,300 col/100mL exceeds the state standard (235 col/100mL) for a single sample and is a full order of magnitude over a typical average concentration for Indiana streams (645 col/100mL).

CLCA Scientific data, which was more comprehensive than the 2001 Diagnostic study data with three August 2005 measurements, found that all drainages were affected by occasional *E. coli* readings that exceeded the state standards but none that exceeded the average concentration for Indiana streams. Data from 2006 CLCA Scientific sampling was not yet available when this document went to press.

Results of the resident survey in the 2001 study indicated that some septic systems are treating larger waste streams than those for which they were originally designed due to home remodeling and greater residence times in the homes. Overloaded or leaking septic systems deliver nutrients and other pollutants such as *E. coli* to adjacent lakes and streams. This can increase the lakes' productivity and threaten human health. Dye testing of septic systems may be a useful way to determine if the septic systems upstream of the sampling point were responsible for the observed concentration.

Major remodeling permits are issued in Kosciusko County <u>only</u> upon Health Department approval of the existing on-site disposal system or ability and requirement to upgrade system. Although faulty septic systems can contribute to *E. coli* loading, it has been the experience (or opinion) of the Health Department that wildlife (ducks and geese) and agricultural run-off contribute more to this problem. Street and stormwater run-off also contribute heavily to *E. coli* loading due to animal waste on lawns, especially near hard surfaces such as driveways, concrete seawalls, and roads. The Health Department indicates that they would welcome the opportunity to assist individual homeowners in meeting a goal of reduced *E. coli* concentrations through implementation of the following actions.

Potential Actions:
- Conduct regular septic tank maintenance.
- Use dye testing to determine malfunctioning septic systems.

- Register with a company to pump your system that automatically comes out once a year to avoid forgetting.
- Upgrade systems where necessary to handle increased loads.
- Conserve water by using low flow fixtures and reducing water use.
- Use liquid soap in dishwashers and washing machines to reduce clogging of septic system leachfield pipes.
- Do not plant trees directly over septic leach fields. If trees must be planted in these areas, use members of the pine family to avoid interference with roots in the systems.
- Educate homeowners on proper disposal of hazardous waste.
- Clean up after pets or waterfowl by disposing of waste in regular garbage receptacles.

5.2.4 Sewer and industrial waste systems

As more people with larger homes and permanent residences use the lakeshore properties, the ability of the land to absorb and treat septic waste is reduced. Implementing some type of sewage treatment system other than the standard septic tank and leach bed will become necessary in order to prevent excess phosphorus, nitrogen, bacteria, and pathogens from entering the lake. There are various wastewater treatment systems available. The standard collection and treatment system utilizes gravity or force mains (pumped) to drain the waste to an existing treatment system (Warsaw) or a new package plant that could be built within a mile of the lake. These systems typically have a high initial cost and regular monthly maintenance costs. Alternatives that may be feasible for Chapman Lake residents include mound systems or wetland treatment systems. Either system can be built for individual residents or for groups of residents where the waste stream can be efficiently collected and pumped to an undeveloped nearby lot. Both mound systems and wetland systems may have a high initial cost; however, the long-term maintenance cost is significantly reduced from that of a typical treatment plant.

Wastewater wetlands typically produce cleaner effluent at the end of a leach field than traditional or mound systems because the wetlands (all flow is subsurface so there is no odor or visible wastewater) are a tertiary treatment added between the septic tank and the leach field. The water entering the leach field after the wetland filter is cleaner than the water leaving a typical leach field. This is particularly true during the summer months, when plants in a wastewater wetland operate at peak evapotranspiration capacity. Due to this clean water, leach fields of wastewater wetlands are significantly smaller than traditional leach fields making them an attractive alternative where limited space is available. Although wastewater wetlands have proven to be quite effective in treating effluent, the Kosciusko County Health Department supports the construction of sanitary sewer along with zoning standards to curb the problems of over-development. Problems associated with development include increased street run-off and loss of soil surface and vegetation to filter run-off.

Potential Actions:

- Complete a Sanitary Sewer Feasibility Study for the Chapman Lakes by 2012.
- Design plans for a feasible sanitary sewer system by 2015.
- Install a sanitary sewer system by 2020.
- Establish zoning standards to curb problems associated with development prior to installing a sanitary sewer system.

5.2.5 Animal waste

Runoff can carry nutrients from animal waste to the lake, increasing the amount of fertilizer that is affecting aquatic plant growth and oxygen depletion.

Potential Actions:

- Dispose of pet waste in solid waste containers to be taken to the landfill.
- Do not wash goose droppings or any animal waste directly into the lake.

5.3 Local Control

Stakeholders at Chapman Lakes recognize an interest in and responsibility for local control and management of land and water policies to protect and enhance water quality in the lakes and associated waterways.

5.3.1 County land use planning and zoning

Kosciusko County has a land use plan in place with zoning that is more stringent than many surrounding counties. Citizens can contact their county commissioners to express concerns about county land use planning and zoning. Commissioners also host forums on issues, including land use, by inviting individuals from various professions to attend and present information on these critical decisions. Specifics regarding land use or zoning changes that recently occurred within the Chapman Lakes watershed are detailed in5.5.1. Despite recent efforts, additional zoning and planning issues were identified as a concern in the watershed.

Potential Actions:

Work with local authorities to develop a zoning master plan for the watershed that establishes guidelines for future development through zoning laws. It could:

- Require specific management techniques be employed to treat storm water.
- Set specific limits on pollutant export from the site.
- Limit housing density in the watershed and commercial development near the lakes.
- Include an erosion control ordinance.
- Review recommendations from the Indiana Lakes Management Work Group.

5.3.2 Involvement of citizens and elected officials

A Kosciusko County Lakes Association (KCLA) provided interaction between the lake associations during the 1990s, but was disbanded in the past few years. The Steuben County Lakes Association remains active in supporting the conservation and education interests of its members. Recently, the CLCA joined with 10 other lake associations within the county to develop and present a lake residential zone proposal to the Kosciusko County Commissioners.

Potential Actions:

- Support CLCA involvement in the coalition of lake associations in the county.
- Review and implement recommendations from the Indiana Lakes Management Work Group on an annual basis as they pertain to the water quality in the Chapman Lakes

5.3.3 Public funds for lake and watershed management

Funds for lake and watershed management can come from many local, state, and federal sources. Currently available funds include pass-through federal money from the U.S. Environmental Protection Agency that are administered by the IDEM, Farm Bill funds for agricultural conservation through the NRCS, and state funds from the IDNR Lake and River Enhancement Program. Kosciusko County does not have funds specifically available for lake management, but supports use of funds from private, state and federal sources. The county does provide services directly related to water quality, such activities administered by the county health department and county surveyor's office.

The Chapman Lakes organizations have successfully applied for many of these funds and have implemented projects in a logical sequence. This plan ensures that those funds will continue to be accessible for protection and improvement of the lakes and their watershed.

Potential Actions:

- Encourage boaters to properly register boats and pay the associated Lake and River Enhancement fee.
- Select actions from this document or develop new feasible water quality improvement or monitoring projects and seek continuing grants for implementation from IDNR, IDEM, and other sources.
- Appoint a Chapman Lake resident or residents to act as the contact(s) and lead for annual grant applications and to oversee and report on any contractor's work.

5.4 Shoreline, Habitat and Dam Management

The viability of recreational and aesthetic resources associated with fish and wildlife habitat are dependent upon land and water management by near shore property owners. Water level maintenance is dependent upon dam and levee management.

5.4.1 Shoreline management and seawalls

Seawalls border the shoreline in front of nearly 80% of the lakefront homes. No significant areas of shoreline erosion were noted during a shoreline reconnaissance survey, likely due to the heavy seawall use on the lakes. The seawalls consist largely of concrete and rock materials. Concrete seawalls are most common in areas that were formerly wetland habitat, although their presence was noted along other areas of the shore as well. Natural shoreline fronted few residences.

Proliferation of piers is largely a social issue. While piers do shade the lakebed and may interfere with plant growth, they also provide some structure for fish. Pier length and configuration can cause safety hazards and block access to shorelines.

Potential Actions:

- Protect or plant rushes (*Juncus* spp.), sedges (*Carex* spp.), pickerel weed (*Pontederia cordata*), arrowhead (*Sagittaria latifolia*), and blue-flag iris (*Iris viginica*) for an aesthetically attractive, low profile native community in wet areas along shorelines.
- Encourage use of rock seawalls instead of concrete.

- Encourage residents to follow IDNR guidelines, which currently recommend the placement of glacial stone in front of the seawall when refurbishing old walls.
- Encourage residents to re-establish aquatic plants in front of seawalls to restore habitat in shallow water where practical.
- Implement ecological protection zones where needed to protect bulrush and other emergent plant beds from disturbance by watercraft and wave action.
- Pass local or encourage state laws, which would restrict the amount of space occupied by all types of temporary structures such as piers, rafts, and trampolines, to minimize the ecological impacts of these structures as well as minimize negative effects on safety, access, and aesthetics on the lake.
- Explore the possible use of lake ecozones.

5.4.2 Dam and levee maintenance

Construction of the new Chapman Lakes levee was completed during the summer of 2005 by the DNR, Division of Water. There was considerable interest in the project statewide because it was the first use of cellular concrete for this application. During construction, the site was closed to the public and access was restricted for safety reasons. The new levee replaced an existing structure, built of weakening muck and marl that was failing. Failure of the existing levee threatened nearly 300 acres of wetlands, both Chapman Lakes and the Pike Lakes downstream in Warsaw.

Figure 3—Chapman Lakes levee construction 2005. Utilizing cellular concrete as the support base, the new levee replaced a failing muck and marl structure. An additional nearly 20 acres of new wetlands was also created. The levee protects nearly 300 acres of valuable wetlands and holds the lake levels at the court decreed elevation.

The Indiana Department of Natural Resources, IDNR is responsible for maintenance of the outlet works on the natural lakes in Indiana; see Indiana Code, IC 14-26-2, 14-26-4, and 14-26-8 and 312 IAC 11-6 for additional information. While some activities by Rule do require local participation, the lake association should not need to establish a fund to maintain existing structures at the present time. The reader should contact the IDNR, Division of Water for specific information regarding the Chapman Lakes outlet works.

The outlet works structure for the Chapman Lake system has had rodent issues over the years. Rodents have both compromised and repaired the old levee system by burrowing into the earthen structures, building dams, and repairing minor breaches. Rodents, specifically beaver, have built dams at the crest of the in-channel dam, the weir portion of the lake level outlet control structure. A beaver dam blocking flow to the outlet weir can result in higher lake levels. The higher levels can lead to erosion adjacent to the outlet with associated loss of lake level control. In December 2000, IDNR installed a Clemson Beaver Pond Leveler in the outlet channel to assist in controlling lake level in an area with beaver activity. This system will not prevent the dams from being built but will help to decrease the frequency and magnitude of the problem. The construction techniques used in the new levee should decrease the vulnerability of the new structure to rodent burrowing and the associated collapse and leakage issues.

Presently Chapman Lake is one of only a few lakes in Indiana that the IDNR maintains a cooperative agreement with the USGS for lake level data collection. This may change in the near future if state resources become more restrictive. The IDNR has indicated a willingness to cooperate with any established lake association to provide base line and staff gage information.

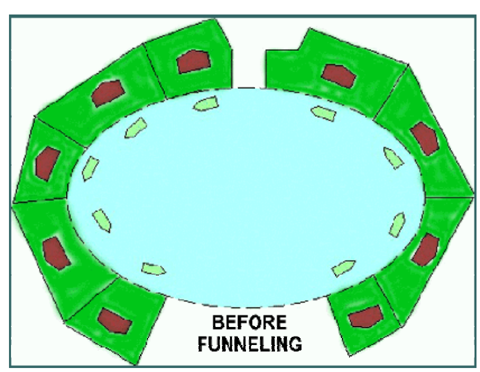
Potential Action:

- The Chapman Lake Conservation Associations should become actively involved in collecting data through the use of a staff gage, pressure transducer, or other means.
- Check for and potentially remove beaver dams from the area of the weir when the lake level readings indicate a potential blockage of the outlet weir.

Online resources:
Related statutes, IDNR Division of Water
http://www.in.gov/dnr/water/statute_rules/index.html.

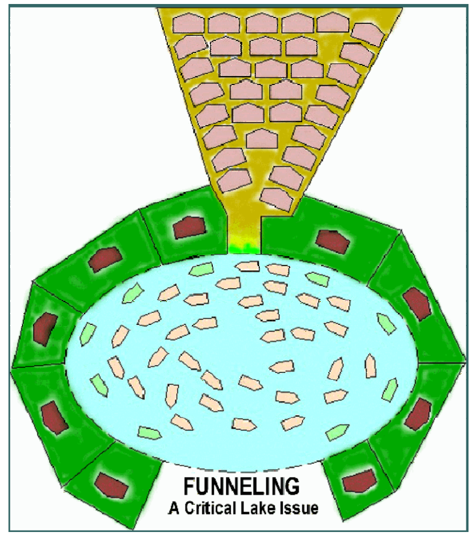
5.5 Urban Development

Urban development can have many impacts on the lake and surrounding region. Economic impacts, such as increased property tax revenue and generation of construction jobs, can be beneficial. Impacts to ecological conditions and rural characteristics can be negative.



5.5.1 Funneling

Funneling is an increasingly critical issue for many lakes as more and more residents seek the joy of lake living. Funneling is described as when someone purchases a lakefront property, acreage near that lake property, and then permits lake access for the now developed larger property's



residents and visitors. A complex political problem for many counties, simplified drawings illustrate the results of funneling.

At right, the top drawing depicts a lake with modest, single-family residences. The one boat shown, is, of course, unusual in today's recreationally minded society. Most lake dwellers own an average of two and one-half motorized vessels. So, it is necessary to consider multiple watercraft at today's Indiana lakes. While the illustration is small, the principles of funneling apply. Note the "vacant" property at the top of the illustration.

In the drawing on the bottom at the right, the "vacant" property has been purchased and become part of an adjacent development. Shown are the simple results a large development with a lakefront access property could have on a lake, considering only boating and boat population. Again, the illustration presumes only one watercraft per household. The lakeshore resident boats are in green, and the development homeowner boats are in pink.

The result can be almost immediate over-use of the lake. The issue is not who has the right to use our natural resources, but the impact an overabundance of people and motorized watercraft can have on the lake ecosystem. Determining exactly how much use a lake can withstand in the constant churning brought about by watercraft is difficult. Many ecologists say the "limit" may only be determined when the ecosystem is near collapse. Solutions are difficult and usually result in a heated, politically charged, debate.

During 2005 and early months of 2006, zoning issues have been increasingly important as the result of lake associations in the county focusing more public interest. CLCA was at the forefront of that effort and worked closely with the Lake Tippecanoe Property Owners Association (LTPO), Lakeshore Development Committee.

In 2005, CLCA directors voted unanimously to join 12 other local lake associations in support of a proposal outlined by the Tippecanoe group. That plan asks Kosciusko County to establish a lake residential zone specifically for property within 2,640-feet of larger county lakes. The new zoning designation would allow more careful planning and restrictions that will protect lakes from such practices as "funneling". Restrictions would enable the county to limit uses of property that could damage lake ecosystems.

While such approaches to the protection of riparian land have been put forward in other states, the proposal to be presented to the Kosciusko County Commissioners, if recommended by the Kosciusko County Planning Commission would be a new step for protection of the lake heritage in Indiana. The proposal for the lakeshore of any lake 10 acres or larger, would affect at least 60 lakes in the county. The plan was presented to the county on September 7, 2005, and discussed at subsequent commission study meetings beginning in October 2005.

Concerns about the "Lake District Zone" proposal have been raised, ranging from a sense that the zoning changes would be overly restrictive to concerns that it is not extensive enough. Others said there was a continuing lack of funding for staff to enforce the measure. As initially proposed, existing commercial enterprises within a half-mile of a lake would all become non-conforming uses even if they have no relationship to or impact on the lake water quality and recreational use. The Lake Residential Zone proposal does not address "funneling" to the lakes and may not go far enough to protect green space around the lakes.

However, the funneling issue was addressed head-on in January 2006 when the county's professional planning staff presented a zoning ordinance amendment that would prevent or dramatically limit funneling by residential developers. At the same time, this new zoning amendment offered an additional change to enhance erosion control enforcement. It would suspend or void building permits and added a financial penalty for those who do not maintain erosion prevention controls. This erosion control change was specifically directed at violators whose control practices threatened a nearby lake or stream.

The funneling prevention amendment, patterned on a similar LaGrange County measure, was clear in its intent:

> "The intent of this provision is to minimize the impacts of Back Lot Development on the Shoreline. Further, it is the intent of this provision to (1) discourage the funneling of **State regulated lakes** lake access for multiple residences through narrow access points, (2) establish a balanced and orderly relationship between development and the amount of Shoreline available for use by residents, and (3) to assure responsible "lake access" for Lakefront Development.
>
> Such Lakefront, **channel front,** or Back Lot Development, including, but not limited to, lake front access points, (1) lake front recreational areas, beaches, parks, playgrounds, regardless of whether such area has been specifically denominated as a common area or access point, whether located in a residential subdivision, apartment building development, condominium cooperative, neighborhood association, or associated with an organization, club, retirement community, mobile home park, mobile home subdivision, subdivisions subject to the provisions of the subdivision control ordinance, and (2) multi-family residential units, mobile home parks, and camp grounds, planned unit development with a residential component, residential development under the horizontal property regime, and platted or exempt residential subdivisions in all zoning districts shall comply with the following linear footage requirements:

First Residential Unit	50 Feet of Shoreline
Second Residential Unit	25 Feet of Shoreline
Each Additional Residential Unit	15 Feet of Shoreline

In its erosion control change, planners stiffened existing language in several sections, including the following that is indicative of those changes:

> "9.11 Erosion and sediment control measures that minimize the amount of sediment leaving a site will be utilized**, including but not limited to properly installed perimeter stabilization including silt fences, stabilization of stock pile area/s, and installation of a stable construction entrance."**

The new enforcement provision, when proposed, read as follows:

> "13.6 Failure to implement any provision laid out under section 9.1 for an individual construction site will result in the immediate withdrawal of Improvement Location Permit. Said permit shall not be released or reissued until the violations are corrected and no work may proceed on said property. If said violations are not corrected within five (5) working days of notification or posting of violation fines, not less than fifty dollars ($50.00) and not more then three hundred dollars ($300.00) shall begin accruing. Enforcement action may be instituted in the name and against the owner and/or the party actually responsible for the violation of this ordinance including but not limited to the owner, lessee, agent or contractor."

Both of these amendments offered by the county staff was seen by CLCA officials as one of the most important steps in assuring the future of Kosciusko County lakes in decades. The ordinance was recommended by the Area Plan commission to the Kosciusko County Commissioners on September 19, 2006 and was passed.

Potential Actions:

- Review and provide informed comment on group pier permits through the recently updated IDNR regulations regarding use of piers by multiple households.
- Change the zoning ordinance to limit the number of single-family residences that can be platted to use one lot for lake access. (All condominiums are already required to get a variance from the Board of Zoning Appeals.)
- Actively encourage support for local anti-funneling zoning ordinances.

5.5.2 Housing additions and population increase

The CLCA has raised concerns about re-zoning acreage within the Chapman Lakes watershed for residential development. Additionally, CLCA has supported a zoning ordinance amendment to establish a Lake District Residential designation. This designation would limited the number of housing units present on particular present on particular parcels based on their proximity to the county's lakes. Many studies document the negative impacts that sediment and phosphorus have on waterbodies. Other studies state that residential land uses deliver higher sediment and nutrient loads to adjacent waterbodies than more natural land uses like forest or wetlands. Based on these data, it is the CLCA's position that maintaining parcels adjacent to the lake in their natural land use would be more beneficial to the lakes than converting these parcels to residential land uses.

In 2005, CLCA opposed rezoning one such property from its designation of agricultural use. Despite the opposition from CLCA and other county lake groups, the county commissioners re-zoned tan 18-cre parcel adjacent to Lozier Drain from agricultural to residential. Commissioners indicated that erosion control mechanisms were currently in place to limit the flow of sediment from construction sites to downstream waterbodies, in this case, Little Chapman Lake. Observers indicated that the commissioners would likely have overturned any action by the planning commission to maintain the existing zoning, thereby allowing the rezoning to occur despite remonstrance against the plan.

In a letter to commissioners, then CLCA President Dan Lee summarized the organizations opposition:

- Contrary to what you have been told, a building subdivision is not a more lake-friendly use of the property, particularly in this location. In fact, a subdivision produces 10 times the run-off that might be created by agricultural use, and more than 100 times the run-off from a well-vegetated site.
- There are already ample residential building sites in Kosciusko County--395 actually listed just a few days ago--a large percentage of which are located in Plain Township.

The challenge for "smart growth" or mechanisms that allow responsible development is that levels of development are value-driven and depend on community perceptions.

Potential Actions:

- Regularly request the Kosciusko County Planning Department to provide CLCA notice of rezoning or variance proposals within the watershed to assure lake residents are aware of variances or zoning changes that could impact lake ecosystems.
- Review and comment on rezoning proposals around the lake and in the watershed.
- Use survey tools or other methods to determine the level of development that would be acceptable to landowners in the county.
- Designate different levels of development for different lakes (similar to the regulation of boat speed based on lake size).

5.6 Aquatic Plant Management

Previous studies conducted by the CLCA in conjunction with grants from the LARE program, have revealed the advancing presence of exotic and invasive aquatic plant species, as well as the increased nuisance of some native species. Projects have been and are now underway at the Chapman Lakes to reduce the phosphorus input from the watershed that can contribute to an overgrowth of aquatic plants in the lakes. Managed control of exotic and invasive species, as well as any overgrowth of other species to promote a more natural lake environment, is needed. Previous studies and surveys have also indicated programs to better educate lakeside residents and lake users on the benefits of native aquatic plants would be beneficial.

An aquatic plant management plan was completed in May 2005, funded in part by a grant from the IDNR Lake and River Enhancement Program and by the CLCA. This document addresses the need for aquatic plant management in the Chapman Lakes, Kosciusko County, Indiana, and addresses those needs in the subsequent five years from the date of this plan. This plan was funded in part, by an Indiana LARE program grant. Technical information was provided under contract with J. F. New and Associates, Inc., Walkerton, Indiana, and Weed Patrol, Inc., Elkhart, Indiana.

The Executive Summary of that plan included:

1. Undertake control of the exotic and invasive species Eurasian water milfoil (EWM) and curly-leaf Pondweed (CLP), over a five-year period. These can qualify for financial

competitive grant assistance from the Lakes and River Enhancement program (LARE) if funds are available. [It is important to note that concerns by the district fisheries biologist limiting approved control efforts in the first year of implementation of this plan to not more than 30 cumulative acres. This was enacted to allow for additional aquatic plant surveys considered necessary during 2005 to assure treatment measures would not alter the lakes' ecosystem. Larger treatment areas are assumed for subsequent years, as warranted.]

2. Management and reduction in areas of an overgrowth of native vegetation, particularly eel grass, over a five-year span. This must be financed entirely from local funds.

5.6.1 Control of invasive plant growth

It is important to note that the aquatic plant management plan is two-pronged in that there are two separate and distinct issues involving aquatic plant management for Chapman Lakes and channels. While control of exotic and invasive species can qualify for LARE funding assistance, these efforts depend upon the availability of program funds and grant approval in competition with others in Indiana. The costs of other aquatic plant issues, including overgrowth of native species, depend entirely upon the ability of the Chapman Lakes community to raise funds for those projects.

This plan does not envision eradication of Eurasian watermilfoil. Control of this invasive species, however, is a stated goal. Additional surveys and study of the aquatic plant community during 2006 and beyond is expected to provide information considered necessary and required by the IDNR district biologist before additional treatments are undertaken. This report anticipates throughout its pages that no aquatic plant control measures be undertaken without the specific approval of the district biologist, as required for permitting purposes.

This initial plan proposed the following:

- Initial year spot treatment of Eurasian watermilfoil (EWM), funded in part by a LARE grant.
- Treatment to control Eurasian watermilfoil in 2006.
- Treatment to eliminate or control curly-leaf pondweed (CLP).
- Spot treatment of any Eurasian watermilfoil in 2007.
- Treatment and management of native plant overgrowth in lakes and channels, including eelgrass, as may be warranted by plant surveys.
- Treatment of algae in problem areas.
- Ongoing annual surveys of lake vegetation.
- Education, as nearly as practical, of property owners and the general public in aquatic plant issues.
- Evaluation of planting selected species of native vegetation in specific areas if native species count does not increase and overall plant coverage is below acceptable levels.

In 2006, the only method of control was chemical in nature and was intended to target Eurasian watermilfoil and curly-leaf pondweed. Both species are exotic to Indiana lakes. On May 24, 2006, Aquatic Control Inc. (Seymour, Indiana) treated approximately 14 acres of Eurasian watermilfoil and 10 acres of curly-leaf pondweed within the two lakes. Two separate treatments occurred targeting two different species. Due to differences in acreage treated and dosage utilized, treatment methodologies differed for the two target species. A low rate of Aquathol K herbicide was used to control curly-leaf pondweed while not harming native pondweeds or other aquatic species. Conversely, since a relatively large area was treated selectively, Eurasian watermilfoil control herbicide (Renovate 3) was applied at a light rate of approximately 1.25 ppm or roughly 4-5 gallons per acre.

A Tier II survey was conducted before and after chemical treatment occurred to determine the nature of the plant community and effectiveness of treatment. In comparing 2006 pre- and post-treatment Tier II survey data, it was found that the relative density and abundance of Eurasian watermilfoil and curly-leaf pondweed decreased in almost all cases. (See the Aquatic Plant Management Plan Update for more details.) The exception to this trend was an increase in relative density of Eurasian watermilfoil in Little Chapman Lake, which increased slightly from 0.24 to 0.30. A follow-up inspection was completed by the applicator and the Association. It was found that the treatment of the 2 acres in the northern part of Little Chapman Lake had not proved as effective as other treated areas. The applicator suspected that since the area was relatively small drift may have been a factor and recommended that potential future treatment of areas less than 5 acres or deeper than 6 feet be treated using 2,4-D or Renovate in their granular forms.

Table 16A. Aquatic plant abundance in Big Chapman Lakein 2006.

Lake:	Little Chapman	Sites with plants:	40.00	Mean species/site:	1.56
County:	Kosciusko	Sites with native plants:	36.00	Mean native species/site:	1.34
Date:	18-Jul-06	Number of species:	10.00	Species diversity:	0.80
Secchi (ft):	2.75	Number of native species:	8.00	Native species diversity:	0.74
Max plant depth (ft):	14	Maximum species/site:	5.00	Rake diversity:	0.68
Trophic status:	eutrophic	Total number of sites:	50	Native rake diversity:	0.59

Common Name	Scientific Name	Site Frequency	Relative Density	Mean Density	Dominance
Coontail	*Ceratophyllum demersum*	42	1.02	2.43	20.40
Northern watermilfoil	*Myriophyllum exalbescens*	20	0.24	1.20	4.80
Sago pondweed	*Stuckenia pectinatus*	18	0.22	1.22	4.40
Eel grass	*Vallisneria americana*	18	0.18	1.00	3.60
Eurasian watermilfoil	*Myriophyllum spicatum*	18	0.30	1.67	6.00
Chara	*Chara spp.*	16	0.24	1.50	4.80
Grassy pondweed	*Potamogeton gramineus*	6	0.06	1.00	1.20
Southern naiad	*Najas guadalupensis*	4	0.04	1.00	0.80
Water star grass	*Heteranthia dubia*	2	0.02	1.00	0.40
Slender naiad	*Najas flexilis*	2	0.02	1.00	0.40
Large-leaf pondweed	*Potamogeton amplifolius*	2	0.02	1.00	0.40
Flat-stalked pondweed	*Potamogeton friesii*	2	0.02	1.00	0.40
Common bladderwort	*Utricularia vulgaris*	2	0.02	1.00	0.40
Curly-leaf pondweed	*Potamogeton crispus*	4	0.04	1.00	0.80
Filamentous algae	*Algae*	78			

JFNew's review of Tier II surveys from 2004-2006 indicate that herbicidal treatment of Eurasian watermilfoil and curly-leaf pondweed are proving successful in reducing both the abundance and relative density of these two exotic species in both Big and Little Chapman Lakes in most cases. In comparing pre-treatment Tier II survey data from 2005 and 2006, data indicate that Eurasian watermilfoil populations in both Big and Little Chapman Lakes and curly-leaf pondweed in

Little Chapman Lake decreased. Curly-leaf pondweed populations in Big Chapman Lake remained largely unchanged in both site abundance and relative density from 2005 to 2006. One possible explanation for this is that curly-leaf pondweed in Big Chapman Lake has historically undergone less rigorous treatment than curly-leaf pondweed in Little Chapman Lake; a more rigorous investigation would be needed to confirm this however. Another possible explanation for the persistence of the curly-leaf pondweed in Big Chapman Lake is that water temperatures during treatment on May 24, 2006 were greater than the ideal water temperature for treating curly-leaf pondweed (40-50 ºF). Treatment at cooler temperatures has greater long-term potential for success since control is implemented before turion development, thus limiting next season's growth potential (Nate Long, Aquatic Control Inc., personal communication).

Table 16B. Aquatic plant abundance in Little Chapman Lake in 2006.

Lake:	Big Chapman	Sites with plants:	83.00	Mean species/site:	2.83
County:	Kosciusko	Sites with native plants:	83.00	Mean native species/site:	2.72
Date:	18-Jul-06	Number of species:	17.00	Species diversity:	0.88
Secchi (ft):	7	Number of native species:	15.00	Native species diversity:	0.86
Max plant depth:	20	Maximum species/site:	8.00	Rake diversity:	0.81
Trophic status:	mesotrophic	Total number of sites:	90	Native rake diversity:	0.79

Common Name	**Scientific Name**	**Site Frequency**	**Relative Density**	**Mean Density**	**Dominance**
Chara	*Chara spp.*	46	1.26	2.76	25.11
Coontail	*Ceratophyllum demersum*	40	0.73	1.83	14.67
Sago pondweed	*Stuckenia pectinatus*	26	0.28	1.09	5.56
Spiny naiad	*Najas marina*	20	0.29	1.44	5.78
Eel grass	*Vallisneria americana*	16	0.16	1.00	3.11
Nitella	*Nitella*	13	0.20	1.50	4.00
Eurasian watermilfoil	*Myriophyllum spicatum*	11	0.21	1.90	4.22
Northern watermilfoil	*Myriophyllum exalbescens*	9	0.11	1.25	2.22
Common waterweed	*Elodea canadensis*	7	0.07	1.00	1.33
Common bladderwort	*Utricularia vulgaris*	7	0.07	1.00	1.33
Grassy pondweed	*Potamogeton gramineus*	6	0.06	1.00	1.11
Curly-leaf pondweed	*Potamogeton crispus*	4	0.04	1.00	0.89
Southern naiad	*Najas guadalupensis*	2	0.02	1.00	0.44
Large-leaf pondweed	*Potamogeton amplifolius*	1	0.01	1.00	0.22
Broad-leaf small pondweed	*Potamogeton berchtoldii*	1	0.01	1.00	0.22
Illinois pondweed	*Potamogeton illinoiensis*	1	0.01	1.00	0.22
Long-leaf pondweed	*Potamogeton nodosus*	1	0.01	1.00	0.22
Filamentous algae	*Algae*	73			

The effects of the treatment on the native aquatic plant community are unclear. Comparing the 2006 pre- and post-treatment Tier II survey metrics indicates that the quality of the native aquatic plant community in both lakes decreased following treatment. The native rake diversity (SDI), native species richness and site species native diversity all decreased following treatment. The number of native plant species found in Little Chapman Lake did not change following treatment. However, the number of native plants found in Big Chapman Lake decreased from 19 to 15.

Additional items including a Tier I Survey; a public meeting; and a meeting between the contractor, LARE program staff, the district fisheries biologist, and a representative from the CLCA, also occurred in concert with this aquatic plant management plan update. The details of these are not repeated here, but were utilized to generate recommendations and potential actions as follows:

Potential Actions:

- Early season assessment of curly-leaf pondweed populations to determine if treatment is necessary. Assessment and treatment should occur when water temperatures are at 30 to 40^{o} C.
- Assessment of channels along Little Chapman Lake's northern shoreline, between the lakes, and along the eastern and northern shorelines of Big Chapman Lake and within Nellie's Bay is also necessary. These areas are thought to act as nurseries for Eurasian watermilfoil. Treatment of these areas should result in less reintroduction of Eurasian watermilfoil from the channels into the main body of the lakes.
- Treatment of approximately 25 acres of Eurasian watermilfoil throughout the Chapman Lakes. Areas are identified in the following sections, but should be confirmed prior to treatment occurring in 2007.
- Continue pre- and post-treatment assessments to determine how the aquatic plant community within the Chapman Lakes changes over time.

5.6.2 Costs and impacts of aquatic plant control

Costs as described in the 2006 update can vary greatly as influenced by competitive bidding, inflationary trends, and chemical effectiveness. Total cost for the treatment, surveys, and meetings in 2007 are estimated at $21,680. Actual treatment costs may range from $8,125 for spot treatments to $100,000 for a whole lake treatment each year of application. However, if a whole lake treatment is applied, control is often achieved for three to five years at a time. It is anticipated that the Indiana Lake and River Enhancement (LARE) program will provide the majority of funding with sponsorship by CLCA or Chapman Lakes Foundation, Inc. Small area projects undertaken by private or residential groups are not projected in this plan. It is important to remember chemical treatment is much like taking medicine; there are possible side effects and consequences that must be considered. There is also study evidence elsewhere that long-term use of herbicides can have a negative ecological impact on a lake. Where invasive plants have become well established, it may be necessary to reintroduce native plants to bare areas that have been treated to remove invasive plants.

Potential Action:

- Monitor costs and treatment results each year and modify treatments as necessary to increase efficiency.
- Monitor native plant populations to make sure they are not affected by treatments.
- See Section 5.6.1.

5.7 Law Enforcement and Compliance

5.7.1 Nonresident familiarity with regulations

Visitors or weekend boaters may not be familiar with watercraft rules.

Potential Actions:

- Provide information to nonresident lake users. The information to be provided will be based on results of the planned *Nonresident Survey*.
- Investigate participation in a citizens enforcement program in cooperation with the Kosciusko County Sheriff's Department, and the IDNR's Enforcement Division.
- Improve sign visibility at all locations.
- IDNR to complete informal survey using a college student or intern.
- Conduct boater education courses.

5.7.2 Boater education

People who don't know laws do not attend boater education courses (don't get information).

Potential Actions:

- Encourage boaters to take boater education courses and follow all regulations.
- Sponsor boater education courses at CLCA's clubhouse in conjunction with an event such as a pancake breakfast to gain larger attendance.
- Provide boater educational handouts at all local events.

5.7.3 Enforcement and compliance

Residents are concerned about violations of watercraft safety regulations, including: not having spotters while skiing or tubing; wakeboarders going over buoys; and speeding. Residents would like to assist with compliance, but find it difficult to obtain registration numbers of noncompliant boats. Watercraft can have an impact on ecological, economic, aesthetic and social aspects of lake life. Full compliance with existing regulations would likely resolve the concern.

Potential Actions:

- Develop plan with the Sheriff to enforce laws and increase lake patrols.
- Utilize new LARE funds available to County Sheriff to train deputy law enforcement officers specifically for patrolling the lake.
- Obtain funding to employ a law enforcement person.

5.8 Boats and Personal Water Craft Pollution

5.8.1 Nutrient resuspension in shallow water

Power boating in shallow waters can agitate and resuspend nutrients from the lakebed.

Potential Actions:

- Encourage boaters to reduce speeds over shallow water through education and use of local law enforcement.
- Explore establishment of ecological protection zones to protect bulrush and other habitat in

shallow waters around selected areas of the lake.
- Dredge areas of accumulated sediment that are not identified as ecological protection zones

5.8.2 Fuel contamination
Fuel contamination from boats can occur with poorly maintained or older engines and during refueling.

Potential Actions:
- Place warning and informational signs at marinas encouraging boaters to be careful when refueling.
- Encourage watercraft owners to maintain or replace older engines.
- Work with the Chapman Lakes Marina and any other public or commercial facilities to minimize fuel spills during in-lake refueling.
- Support restrictions on group piers to limit fuel spills.
- Work with the Chapman Lakes Marina to post warning signs concerning fuel spills.
- Submit proposal that fuel contamination be added to County ordinance regarding the group piers.

5.8.3 Noise
Noise from jet skis and loud boats affects wildlife and aesthetic enjoyment of the lakes by recreational users and residents around the lake.

Potential Actions:
- Develop speed statute recommendations for submittal to Indiana Lakes Management Work Group (ILMWG) for implementation.
- Present group pier restriction proposal to ILMWG for implementation.

5.8.4 Nuisance Species and Invasive Species
Aquatic nuisance and invasive species can hitch a ride on clothing, boats, and items used in the water. When aquatic enthusiasts go to another lake or stream, the nuisance and invasive species can be released. If the conditions are right, then these introduced species can become established and create severe problems. The current list of invasive species that inhabit inland aquatic habitats within the Chapman Lakes and their vicinity includes Asian clams, zebra mussels, purple loosestrife, common reed, Eurasian watermilfoil, and curly-leaf pondweed. Nuisance species identified by the task force as present in the Chapman Lakes include Canada geese, mute swans, muskrats, beaver, carp, gizzard shad, groundhogs, zebra mussels, Eurasian watermilfoil, curly-leaf pondweed, and eel grass.

Once invasive species are introduced, control can be difficult or impossible. This is particularly true for exotic fish, zebra mussels and other aquatic animals. Some invasive species can be partially controlled through removal and designing habitat conditions that are not conducive to that species, including geese, beaver, muskrats, and groundhogs.

Potential Action:
- Maintain a buffer zone of native plants, including shrubs, flowering plants, and grasses, that are allowed to grow to heights of 12-18 inches or more to discourage geese from leaving the

water and entering onto lawns.
- Encourage fishing for nuisance fish.
- Monitor the mute swan population.
- Obtain volunteers to inventory shoreline areas annually for patches of invasive wetland species, such as purple loosestrife and common reed (*Phragmites*).
  - Release beetles into the area as a biocontrol if infestation of loosestrife is found.
  - CLF to develop a plan to keep invasive species from continuing to spread.
  - CLF to inventory and stake shoreline for monitoring the spread of purple loosestrife.
  - CLF to set low level control points for future monitoring.
  - CLCA Scientific to conduct Tier II survey annually.
- Request LARE funding to aid in the control of purple loosestrife before it becomes a problem.

5.8.5 Prevention

According to the Stop Aquatic Hitchhikers™ national campaign, lake users can stop aquatic hitchhikers by following a simple procedure each time they leave the water. Knowing which waters contain nuisance hitchhikers is not as important as doing these procedures every time they leave any lake, stream or coastal area.

Responsible pet and landscaping choices can also protect the lakes. Water gardens are becoming a popular part of the landscape, but unfortunately many of the plants that are sold for these manmade ponds are non-native and some of them have proven to be quite invasive (Brazilian elodea, yellow floating heart, hydrilla, and European frogbit to name just a few). Aquarium pets show up in waters around the state and were likely released illegally; species found in Indiana included piranha, pacu, aruana, alligators, and others.

Potential Actions:
- Join the Stop Aquatic Hitchhikers™ and Habitattitude™ national campaigns by signing on to the website and using outreach materials available at: http://www.protectyourwaters.net/and http://www.habitattitude.net/
- Encourage resident and nonresident lake users to:
  - Become informed and take action.
  - Remove any visible mud, plants, fish or animals before transporting equipment.
  - Eliminate water from equipment before transporting.
  - Clean and dry anything that came in contact with water for a minimum of 5 days before taking the watercraft to another water body to kill zebra mussels and other invasive species. (Boats, trailers, equipment, clothing, dogs, etc.). Note that one cannot effectively dry a carpeted boat trailer bunk with a towel.
  - Never release plants, fish or animals into a body of water unless they came out of that body of water. This means:
    - Do not release plants into a body of water unless they came out of that body of water.
    - Dispose of unused bait in the trash, never release into the water.
    - Do not transport and release fish from one body of water to another as this is considered stocking, fish stockings are illegal unless a permit has been issued from the Division of Fish and Wildlife.

- Do not release aquarium fish or water garden plants and animals into Chapman Lakes, again this would classify as an illegal fish stocking or could violate other regulations.
- Encourage landscaping using native plants or plants that have not been shown to become invasive.
- Consider supporting laws that require boat cleaning to reduce aquatic nuisance species transfer.
- Promote all action ideas on the website and newsletter.

5.9 Public Access

The Chapman Lakes are legally defined as public waters according to Indiana statute. Access to the water provides eligibility for use of public funds for lake enhancement activities, allows IDNR Division of Fish and Wildlife to maintain a public boat launching site, and allows the IDNR Fisheries Section to conduct scheduled fish population surveys during which limited sampling for water chemistry and aquatic plants is conducted. Recent improvements include an American's with Disabilities Act (ADA) compliant parking pad, public toilet, new concrete ramp, and blacktop parking lot. Because of the lot size has limited vehicle and trailer parking, the CLCA has allowed parking at their clubhouse which is less than 200 yards from the public landing. Continuing this parking access allows more visiting watercraft to be on the lake while keeping the roadside (nuisance parking) to a minimum.

5.9.1 In-lake watercraft capacity

The Lakes Management Work Group and others have discussed whether it may be possible to identify a boat number per acre that defines thresholds for negative impacts. No studies have been conducted in the state of Indiana to determine the watercraft capacity of natural lakes for ecological, aesthetic, or recreational purposes. It may be reasonable to predict that more boats on the water will detract from user satisfaction, diminish aesthetic values, add to ecological impacts, and increase safety issues.

Even if boating capacity were defined, it may be difficult to enforce numerical limits. The watercraft capacity issue might be better served by addressing any development that will exponentially increase boat numbers per riparian lake front acreage such as condominiums, campgrounds, and other new housing developments in and around the lake with deeded lake easements and boat piers. Future consideration of regulating lakeshore owners for the number of watercraft docked at a pier or in use at one time may also be necessary.

Property owner surveys in 1999 and 2005 reinforce the belief by riparians that boating, particularly high speed boating and personal watercraft use has increased markedly in recent years. While it is possible to physically count the types and number of vessels moored at piers, determining the number of vessels on the lakes during any given period requires a prohibitive number of volunteers on the lakes continuously during peak season and throughout the long daylight hours. Additionally, the shape of Big Chapman Lake makes counting vessels particularly difficult from any single vantage point.

In an effort to assess the impact of resident and non-resident boaters on the Chapman Lakes, CLCA conducted a boat survey during 2005 and 2006. Individual counts of boats at docks and within yards occurred on the July 4th weekend in both 2005 and 2006. Additionally, a camera was mounted at the public access ramp to count the number of boats entering and leaving the lakes. Individuals viewed the tape to assess how long individuals remained on the lake as well. Count of vessels using the public ramp is accomplished 24-hours a day, seven days a week throughout the year through the use of a nearby fixed video camera attached to electronic recording equipment. Every vessel entering or leaving via the public boat ramp is recorded. Vessels doing so after dark, however, are not identifiable. Volunteers physically view recorded images to ascertain type of vessel for further informational purposes. Private ramps at Lozier's and Chapman Lakes Marina were not tabulated.

The count of vessels moored at piers during the peak two weeks in 2005 resulted in a count of nearly 1100 boats on both Big and Little Chapman Lakes. While so-called high speed watercraft (ski, bass, personal watercraft) make up the majority of vessels moored, and presumably in use, pontoons make up the largest single boating category. Obviously, most vessels are moored on the big lake.

	Big Chapman	Little Chapman
Total # Piers	459	154
Ski Boat	187	42
Personal Watercraft	146	25
Bass Boat	39	22
Pontoon	265	107
Rowboat	31	8
Sailboat	8	4
Fishing Boat	68	29
Paddle	66	21
Canoe/ Kayak	16	5
Vessel Totals	826	263

More than 1,560 vessels entered Chapman Lakes via the public boat ramp June 19, 2005 when equipment was placed in operation, through the Labor Day weekend. A malfunction of the new observation equipment prevented an accurate count of vessels during the July 4th weekend, although it is clear peak usage of Chapman Lakes by the transient public is during the three week period around July 4th. The large majority of vessels entering the lakes were ski boats, personal watercraft and bass boats. Those three categories made up a total of 87.7 percent of all boats coming to the lakes during summer season 2005. It should be noted that tabulations indicate more than one-half the bass boats enter the lake during a weekday.

Because the system was not in place during the full year, including the usually busy Memorial Day weekend, and was out of service for technical reasons on three occasions tabulations for 2005 are only indicative of future results. Total counts June 19 through Labor Day at the public ramp (includes down time estimates), are as follows:

Ski boats	398	Row Boats	3
Personal Watercraft	261	Sail Boats	0
Bass Boats	715	Law Enforcement	47
Pontoons	118	Other	23

Potential Actions:

- Conduct a literature search to review research available from other states on watercraft capacity in lakes so that this information can be extrapolated to Chapman Lakes.
- Design and conduct a survey to determine the impacts of watercraft crowding on ecological, aesthetic, safety, and recreational user satisfaction.
- Should survey results indicate overcrowding, restrict parking, fishing tournaments and non-resident use of the lake. Note: CLCA is currently not opposed to the six existing fishing tournaments that currently utilize the lake, but are concerned that additional tournaments may be a burden on the lake.
- Petition Natural Resource Commission to regulate tournaments on the lake.
- Monitor transient use of lake for 3 – 5 years.

5.9.2 Public access and parking

The IDNR encourages the use of its public natural lakes and provides free access and parking. The Chapman Lake public access site and available parking is very limited. During summer weekends, parking at the site is often over flowing onto the county road and lake access is often blocked by trailers and cars parked within the access ramp. A "courtesy parking plan" at the Chapman Lake Conservation Association Clubhouse exists for alternative parking when the public access parking lot is full. The seasonal "courtesy parking plan" serves to reduce congestion at the ramp; however, it also increases the in-lake boat density. The courtesy parking plan (along with roadside parking restrictions) can be one way to address the in-lake boat capacity concerns.

Of special note, the clubhouse grounds were closed to casual parking three years ago when vandalism increased. In 2005, a test "courtesy parking plan" was initiated by allowing overflow boat ramp vehicles to park on the clubhouse grounds for a $5 daily courtesy parking permit donation. Under the trial plan, visiting boaters could go to the Chapman Lakes Marina, secure a courtesy parking permit to display on their vehicle dash, and park where designated on the clubhouse grounds. Those without permits risked being towed-away. The plan worked fairly well in 2005.

Potential Actions:

- Evaluate the impact of use of public access and additional parking.
- Analyze information provided by IDNR (Division of Fish and Wildlife) comparing public access and ramp parking with other similar sized Indiana lakes.
- Provide and support additional law-enforcement to ensure that cars, trucks and trailers are not left on the street and by encouraging people to park at the CLCA Clubhouse.
- Request IDNR to stripe the Public Parking and mark tow-away zones at ramp.

6.0 Issues of Concern to Watershed Stakeholders

6.1 Prioritization of Water Quality Issues and Corresponding Goals

Community leaders identified 13 issues as top priority concerns for the Chapman Lakes and their watershed, based on the list of concerns identified at the public meeting on August 13, 2005 and at a Task Force meeting on March 16, 2006. This process was not a scientific survey, but a means of identifying key community concerns at this point in time. Feasibility of taking action on any particular issue, connections between topics, and changes in social and scientific understanding of these issues are likely to affect future prioritization. Issues and potential actions to address them were ranked as follows:

Issue 1: Watershed management and erosion control

- Implement 70% of Watershed Management Plan actions within five years.
- Maintain current wetland and woodland acreage/areas in watershed.
- No increase in livestock in the area.
- Initiate better communication between County Engineer and lake residents regarding road repair, installation and maintenance of storm drain improvements and roadside drainage within the watershed.

Issue 2: Water quality, clarity and depth

- Improve the Little Chapman Lake average secchi disc reading one foot in five years.
- Improve the Big Chapman Lake average secchi disc reading by six inches in five years.
- Lower the average mid-lake phosphorous reading 36% to 0.07 mg/L (general national benchmark is 0.03 mg/L, Chapman Lake had an a summer 2005 average concentration of 0.11 mg/L)
- Meet the state standards for E-coli readings (235 colonies per 100mL).

Issue 3: Septic systems and sewers

- Complete a sewer feasibility study by 2012.
- Educate property owners regarding increased land value due to sewers.
- Educate property owners on the necessity of having septic tanks pumped biannually.
- Encourage the County Health Department to regularly check septic systems on Chapman Lake.
- Follow the Kosciusko Development, Inc. (KDI) 1990 Sewage Advisory Commission Report recommendations.

Issue 4: Local control, Urban Development and Public's expectation for use of the lake

- Work with County Commissioners to developing laws that limit funneling.
- Lobby for lake districting ordinances with commissioners.
- Potentially restrict lake access by parking or tournament limitations

Issue 5: Shoreline, habitat and dam management

- Promote natural shorelines and ecosystem protection zones for sensitive areas.
- Support the 2005 Plant Management Plan and update as necessary
- Protect existing wetlands and shoreline habitat, as well as the dam.

- Conduct annual dam inspections and install a gauge to monitor water levels.
- Maintain current water level.

Issue 6: Stakeholder involvement and plan development

- Update the Strategic Lakes Management Plan (plan) every five years.
- Discuss plan priorities at annual CLC meeting with stakeholders.

Issue 7: Law enforcement and compliance

- Enforce law forbidding high speed boating within 200 feet of shoreline.
- Enforce boating speed limits.
- Support increased lake patrols by County Sheriff by acquiring boat and volunteer deputies within five years.
- Maintain visible enforcement boat on lake (visibility promotes compliance)
- Use large informational signs where needed to warn boaters of laws

.

Issue 8: Boats and personal watercraft

- Monitor boating activity and opinions to insure that the Chapman Lakes do not become too crowded for the continued enjoyment by all users.
- Obtain 95 percent compliance with boating laws on lake with five years

Issue 9: Nuisance wildlife and invasive species

- Reduce invasive plants on lake to less than 5 percent of the plant community in five years as monitored by the annual surveys.
- Identify and control other invasive species on lake immediately.
- Reduce goose population by 50 percent within five years.

Issue 10: Public access

- Research literature and conduct surveys to develop a realistic watercraft carrying capacity for the Chapman Lakes within five years. Upon reaching a conclusion of an appropriate carrying capacity, initiate controls on fishing tournament access, public parking availability, or limits on numbers of boats per pier and numbers of piers spaces to limit the number of water craft to an acceptable level.

6.2 Resources to Address Concerns and Monitor Impacts

The following resources are for the Chapman Lake Stakeholders can use to following up on issues and actions discussed in this Strategic Lakes Management Plan. Additional resources should be added to the plan as they are required or encountered and these resource contacts should be updated very five years. The contacts are current as of January 2007. Responsibilities of the specific agencies are addressed in Section 2.2 of this document. Reference the state or federal website for each entity for the most up-to-date contact information.

6.3 County Offices, contacts and Responsibilities

County Commissioner – Ron Truex 574-372-2433
County Building permits – Contact planning commission 574-372-2304
County Engineer – Robert Ladson 574-372-2356
County Extension Service-Kelly Easterday 574-372-2340

County Health Department–Bob Weaver, Director, Neal Brown, septic 574-372-2349
County Highway Department–Dennis Pletcher, roads or Warren Gruenewald drainage 372-2356
County Sheriff- Aaron Rovenstine, 574-372-5667
County Surveyor and Drainage Board-Richard Kemper, Surveyor 574-372-2366
County Zoning and Planning-David Richards or Mathew Sandy, 574-372-2304

6.3.2 IDNR Offices, contacts, and responsibilities

Division of Water, Permit issues - James Hebenstreit, 317-232-4160 or 877-928-3755
Division of Water, Dams and Levee Section – George Crosby, 317-232-4160 or 877-928-3755
Division of Fish and Wildlife, Fisheries Biologist- Jed Pearson, 260-244-6805
Division of Fish and Wildlife, LARE Program- Kent Tracey, Doug Nusbaum, 260-244-5613
Division of Nature Preserves –John Bacone, 317-232-4054
Division of Law Enforcement – Lt. John Sullivan, 574-457-8092
Division of Engineering – Tom Hohman or Dale Gick, 317-232-4147
Soil and Water Conservation District – Darci Zolman or Linda Hixson 574-267-7445 ext. 3

6.3.3 United States Department of Agriculture (USDA) office and responsibilities

Natural Resources Conservation Service-Sam St. Clair, 574-267-7445 Ext. 3
Farm Services Agency- Leila Knoblock 574-267-7445 ext 2
Arrow Head Country RC& D – Randall Moore 574-946-3022

6.3.4 Indiana Department of Environmental Management

Office of Water Quality- Jamie Robb 317-233-2473
Biological Survey Section – Charles Bell 317-232-8603

6.3.5 US Army Corps of Engineers

Regulatory Branch, Louisville District, Indianapolis Field office-Tim Smith, 317-532-4227
Engineering Branch – Louisville District, 502-315-6220

7.0 Goals, Objectives, and Action Plan for land and water conservation

The following goals and action plan are a result of several public meetings. Once the watershed survey was completed and the baseline water quality data was reviewed, watershed stakeholders met to identify those issues that were of greatest concern in the watershed and set goals to address those issues. The sources identified through this process are the ones targeted in the action plan. The plan includes measures to address each of the identified sources in the agricultural community and from residential and county-owned land. The plan also includes mechanisms to help identify and pinpoint additional sources where not enough existing data could be identified.

As noted above, the stakeholders prioritized the goals during a public meeting. Stakeholders considered the environmental, economic, and social impacts of their actions. Stakeholders took economic concerns into consideration by designing a management plan that for the most part could be implemented by active volunteers. Additionally, the monitoring of the success of the plan could also be completed by volunteers. Most of the actions items that cannot be completed by a volunteer work force can qualify for funding from a known source. This funding might be used to hire a consultant to complete the work that volunteers cannot undertake. The social impact of the plan was considered in the fourth goal. Stakeholders agreed increased stakeholder education and involvement in watershed management was of primary importance. The action plan also includes a number of action items designed to increase the public's awareness of the value of the natural resources in the Chapman Lakes watershed.

Goal 1: Improve the water quality in Big and Little Chapman Lake within ten years by lowering sediment and nutrient concentrations in the lakes and streams.

Objective A: Maintain or improve the Big and Little Chapman Lake average Secchi disc readings (increasing water clarity) by lowering the average mid-lake total phosphorous reading in both lakes.
Actions:

- Continue frequent CLCA Scientific monitoring of both lakes and incoming streams to determine accurate baseline secchi depth and phosphorous values for each lake and to establish whether or not improvements have occurred.
- (Detailed instructions on how to calculate baseline secchi depths are listed in Minnesota Lakes Association Sustainable Lake Workbook. Available online at http://mnlakes.org/main_dev/workbook.cfm)
- Complete proposed dredging projects.
- Implement the proposed watershed projects from LARE feasibility studies including projects on the storm drains to the lake, Lozier and Highland Drain, and the upper end of Crooked Creek.
- Use the display board at the public landing, newsletters, website, handouts, and road or yard signs to educate property owners and lake visitors about phosphorus sources (fertilizers, pet waste, wildlife, and detergents) and the effects that phosphorus has on the lake water quality.
- Insist that all local residents maintain septic systems on a regular schedule until a public sewer system is installed.

Objective B: Promote natural shorelines and ecosystem protection zones for sensitive areas while controlling invasive species in the lakes.
Actions:
- CLCA to encourage natural shorelines using newsletters and programs.
- Appoint individual to work with IDNR on identifying and implementing an appropriate Ecosystem Protection Zone in naturally shallow areas of the lakes.
- Implement Aquatic Plant Management Plan.

Objective C: Maintain current wetland and woodland acreage in the watershed.
Actions:
- Create a map of all existing woodlands and wetlands in the watershed.
- Identify potential areas for woodland and wetland restoration on the same map.
- Oppose attempts by landowners to convert these areas to other uses.
- When areas are lost attempt to restore one of the potential sites identified.

Goal 2: Consistently meet the state standards for concentration of *E. coli* bacteria within the Chapman Lakes and within the streams that flow into the lakes.

Objective A: No net gain of livestock in the area.
Actions:
- Create map showing existing livestock area(s).
- Update map as land use changes in the watershed.
- Seek out advice and assistance from SWCD or NRCS staff if new livestock operations are begun.

Objective B: Educate watershed residents on *E. coli* sources and how they can reduce *E. coli* levels.
Actions:
- Use education material to convince watershed landowners to clean septic tanks regularly.
- Educate watershed landowners on proper methods for disposing of pet or other animal waste.

Objective C: Encourage the County Health Department to regularly check septic systems located within the watershed of Big and Little Chapman Lake (Neal Brown, is the current septic inspector for Kosciusko County Health Department).
Actions:
- Appoint a representative to get to know the local health inspector
- Develop incentives for residents to clean their septic tanks

Objective D: Follow the Kosciusko Development, Inc. (KDI) 1990 Sewage Advisory Commission Report recommendations (see below).

Summary of Recommendation:

1. The county should be involved in development of sewers in unincorporated areas. The county should adopt the "regional authority" approach to provide a coordinating umbrella organization.

2. The county and appropriate towns and townships should work together to address construction of a sewage and septage treatment facility in the central part of the county.

3. The general areas for joint sewer collection and treatment recommended by Jones and Henry are considered viable. Lake areas and/or communities should be encouraged to work together as much as possible. Areas without urgent needs, at this time, should be reviewed for placement at a lower priority or exclusion.

4. Constructed wetlands should be preferential consideration over traditional treatment for unincorporated residential and lake areas, wherever possible, as a means of reducing costs.

5. User fees are a given as the major source of revenue in financing projects. The authority should seek grant and low-interest loan funds as the first priority for additional resources in funding projects. General property taxes should not be used for project funding. Given that state and federal funding opportunities are minimal, the Economic Development Income Tax is recommended as a means of reducing user fees to moderate the impact on low and fixed income residents. It is specifically recommended because of its flexibility to address other capital projects beside sewers.

<u>Objective E</u>: Complete a sewer feasibility study by 2012.
<u>Actions:</u>

- Appoint committee to request Statement of Qualifications (SOQ's) from select Engineering firms for review of qualifications by end 2007.
- Committee to review SOQ's and select three firms to provide a proposal for a sewer system feasibility study in 2008.
- Use the cost estimates provided in the proposals to seek state or federal grants to pay for the feasibility study.
- After grant is awarded select firm to complete a study that determines the most efficient system available.
- Use feasibility study to identify and apply for necessary design grant funding.
- Complete design of sewer system by 2015.
- Committee to pursue implementation funds as soon as design is complete.

Goal 3: Educate a minimum of 50 percent of the landowners within the Chapman Lakes Watershed on at least one of the water quality issues facing the Chapman Lakes and have at least 50 percent of those landowners implement one water quality improvement project within the next 5 years.

Objective A: Educate watershed property owners on sediment and nutrient issues
Actions:

- Use newsletters, website, and handouts to educate lakeshore property owners about phosphorus sources and effects.
- Support and participate in the recently developed Kids Lake Science Camp.
- Place free information cards at the boat landing.
- Maintain or place new information on boat landing signage regarding nutrients.
- Continue putting short informational articles on nutrient and sediment problems on CLCA website and in the Making Waves newsletter.
- Place "Drains to Lake" labels on all watershed roadside drains.
- Consider having members present lake science talks at local schools.
- Utilize local media (radio, newspaper and television) to publish occasional articles, or broadcast news stories on events or projects that reduce sediment or nutrient input to the lakes.
- Consider asking for a crew of volunteers that would display a series of smaller yard signs educating in "sound bites" during the appropriate season.

Objective B: Educate watershed property owners on waste disposal systems
Actions:

- Use newsletters and website to publish property value increases from other lakes of which a sewer has been installed in the past 20 years (Webster, Wawasee, Witmer, Big Turkey, Oliver, and Lake-of-the-Woods).
- Educate property owners on the necessity of having septic tanks pumped biannually.
- Use newsletters and website to publish articles on septic system construction.
- Invite septic hauler to present a program on system maintenance and repairs.
- Invite Health Department to give program on alternative septic system designs.
- Appoint a shoreline property owner as the local expert that others can go to with questions without fear of having to overhaul their system.
- Publish contact information for local expert in CLCA newsletter and on official website

Objective C: Educate lake users on boating laws and invasive species
Actions:

- Maintain a clearly visible sign at the public boat launch regarding boating rules and invasive species.
- Maintain smaller strategically placed signs around the lake on buoys, channel markers, or private piers.

Goal 4: Successfully manage Chapman Lakes use or the enjoyment of all users.

Objective A: Support and strengthen the recently passed Kosciusko County funneling ordinance.
Actions:
- Appoint individual or committee to work on supporting the funneling ordinance.
- Follow up on all requests for “group piers” or “marinas” through the IDNR to keep a record of exemptions and allowances.
- CLCA to sign up for receiving IDNR public notices for permit applications on Chapman Lake.

Objective B: Lobby for lake districting ordinances with commissioners.
Actions:
- Appoint individual for responsible communication with commissioners on lake districting issues.
- Attend any open planning and zoning or commissioner meetings where work is being proposed within a lake district.

Objective C: Develop a realistic watercraft carrying capacity for the Chapman Lakes within five years.
Actions:
- Continue evaluation of watercraft use and capacity.
- Complete occasional residential survey to determine how lake residents view watercraft use on the lake.
- Complete literature research regarding watercraft carrying capacity issues and reporting of results to Task Force or CLCA for subsequent action.
- Potentially restrict guest parking on CLCA property for public boat launch, enforce no roadside parking rules, and petition the IDNR to limit fishing tournaments if research indicates that Chapman Lakes are at or near carrying capacity for watercraft.

Objective D: Support increased lake patrol efforts by County Sheriff
Actions:
- Establish volunteer deputy program.
- Appoint a volunteer lake property owner as the sheriff contact.
- Obtain designated enforcement boat through raffle or donation.
- Make enforcement boat extremely visible and place IDNR logo on the boat.
- Keep enforcement boat moored on a visible pier within sight of the public launch throughout the boating season even when not used for patrolling.
- Deputies to enforce law forbidding high speed boating within 200 feet of shore, current boating speed limits, and other boating laws.
- Deputies to concentrate on education and information.

Goal 5: Successfully manage nuisance species of plants and animals on Big and Little Chapman Lakes. This will be measured based on the dominance within the community on a whole lake basis.

Objective A: Reduce invasive aquatic plant dominance in the lakes to less than five percent of the aquatic plant community in five years.

Actions:

- Appoint an individual or Committee or hire a contractor to be responsible for implementing the Aquatic Plant Management Plan and updating CLCA with changing goals and actions within the plan.
- Use CLCA Scientific surveys to fully update the Aquatic Plant Management Plan once every five years.
- CLCA Scientific annual aquatic plant surveys to determine compliance.
- CLCA Scientific to identify invasive plant species and report to CLCA Board with recommendations as needed.
- CLCA Scientific to utilize certified volunteers to herbicide individual invasive plants or small groups of plants as identified after obtaining appropriate permits.

Objective B: Identify, monitor, and control as necessary other invasive species on the lakes.

Actions:

- Establish a committee or hire a contractor to address invasive wildlife species.
- Begin a program to census zebra mussel population densities.
- Establish method for surveying Canada geese and Mute swan populations.
- Conduct annual surveys of zebra mussels.
- Implement controls as necessary.

Goal 6: Successfully manage the water level on Big and Little Chapman Lakes.

Objective A: Maintain current water level.

Actions:

- Appoint a volunteer or hire a contractor to obtain a cost estimate for a gauge and request funding from CLCA or the CLF to purchase the gage for the dam.
- Appoint volunteer or hire a contractor to purchase and install gage with IDNR assistance.
- Perform annual dam and levee inspection and report status to CLCA.
- Remove any debris from the dam spillway and control structure.
- Report any leaks or cracks in the dam or levee to CLCA and IDNR.

Goal 7: Maintain the Strategic Lakes Management Plan as the primary guide for improving the water quality and the recreational resources within and around the Chapman Lakes.

Objective A: Implement Strategic Lakes Management Plan actions within five years.
Actions:
- Develop implementation timeframe for the pursuit of actions listed within the plan and then designate a person or persons responsible for implementing that action.
- Request updates quarterly or as needed throughout the year from the responsible person or persons.
- Have a posted check list of the actions and completion dates at the clubhouse.
- Celebrate the accomplishment of tasks by rewarding those responsible.

Objective B: Update the Strategic Lakes Management Plan every five years.
Actions:
- CLCA to maintain an active SLMP Task Force.
- SLMP Task Force to submit quarterly report to CLCA on progress.
- SLMP Task Force to meet annually to review progress and brainstorm on new actions items.
- SLMP Task Force to seek public input on plan through CLCA newsletter and website.
- SLMP Task Force to physically update the plan every five years with new goals and action items developed with community input from meetings and surveys.

Objective C: Discuss plan priorities at annual CLCA meeting with stakeholders.
Actions:
- SLMP Task Force representative to present summary of completed actions for the previous year and proposed actions for the upcoming year at annual CLCA meeting.
- SLMP Task Force to appoint secretary for annual meeting to record statements and document desired stakeholder priorities.

8.0 Action Plan for Education, Outreach and Marketing

8.1 Introduction

The ultimate goal of the Chapman Lakes Strategic Lake Management Plan is to create a strong public awareness of our finite natural lake resource and the drainage area of which it is a part. This should result in conscious, enthusiastic support of practices, which lead to cleaner, healthier lakes.

To reach that goal, the marketing of the SLMP is a necessary ongoing task due to the constant addition of new lake visitors and watershed residents. Reaching out to the new visitors and residents as well as existing ones is a difficult undertaking given the shear number of competing messages and media people are exposed to on a daily basis.

Most "typical" marketing schemes employ tired products such as brochures, meetings, and the like. Most lake users today have "been there, done that" and will be unimpressed with similar efforts. Therefore, communication with local transient users must be noteworthy, exceptional, or highly unusual to be effective…. D.C. Lee, 2006.

To date, efforts to educate and inform local residents of watershed issues have been fairly good. The following survey results (Table 17) were collected in 2005 by the Chapman Lakes Conservation Association in a survey conducted by mail.

Table 17. What is your most trusted source of information about lake issues?

Making Waves association newsletter	55.69 %
Chapman Lakes website	18.26 %
Local Newspapers	11.08 %
IDNR fish and wildlife biologists	4.79 %
DNR Publications or websites	4.49 %
Other	2.40 %
University research publications or website	1.50 %
Local bait shop	1.20 %
Professional anglers or hunters	0.60 %
Local TV news	0.00 %
Radio Stations	0.00 %

Survey respondents point to the Making Waves newsletter as a trusted and most read source of lake information, as well as the CLCA web site. CLCA membership at January 2006 numbered more than 500 persons, representing 311 of the 716 single residential family properties on the Chapman Lakes. While association membership continues to grow annually, non-members and transient visitors to the lakes, however, are not reached by either of these sources of information. To reach even more of the population visiting or residing in the Chapman Lakes Watershed the following Marketing Plan has been developed.

8.2 Target Audiences

8.2.1 Residents and Property Owners who live on or adjacent to the Chapman Lakes

Group 1—Association Members
Group 2—Non-Members

Members can be reached through the CLCA newsletters, annual events, and the website as is currently practiced. Non-members get an annual mailing and have access to the website but are not as likely to receive information from the same sources as members. Recruiting new members for the association will help in the marketing of information in this plan, but more likely what we will need is for existing members to display or convey messages in writing or through word-of-mouth on ways to improve water quality in the lake. Ways to communicate to this group are found in Section 8.3.

8.2.2 Transient Visitors to the Lake

Group 1 – Fisherman
Group 2 – Recreational boaters

Visitors to the lake include those that come to fish and those that come to recreate utilizing watercraft like jet skis, power boats, or other potentially polluting devices on the water. Many are here to visit with friends or family who live on the lake. Visiting fisherman are probably best reached at the public landing with attractive signage or "Free-for-the-taking" literature like wallet cards. Personal contact works the best for all visitors but especially well with friends and relatives. The overall message has to be "respect the lake". How we accomplish delivering that message is detailed in section 8.3.

8.2.3 Residents, Landowners, and Visitors of the Watershed not utilizing the Lakes

Group 1- Landowners and residents
Group 2 - Visitors

People who live in or visit the area that drains to the lake (watershed) but generally do not utilize the lake are one of the hardest groups to reach. This group includes people just driving through the watershed but mainly applies to land and homeowners off the lake. Reaching these folks requires cooperation from news media, clear attractive signage with short positive messages, and word of mouth. Section 8.3 has several methods specifically targeted for this group

8.2.4 Government Service Agencies

Group 1 - County Highway Department
Group 2 - County Health Department
Group 3 - County Planning and Zoning
Group 4 - County Sheriffs
Group 5 - County Surveyor/Drainage Board
Group 6 - Commissioners

Establishing a working relationship between Chapman Lake residents and the various County agencies that have jurisdiction over matters that directly or indirectly affect the water quality in Chapman Lakes is extremely important to successfully implement a watershed management plan. Successful marketing of this plan to the personnel who direct those agencies is best accomplished by word of mouth through personal relationships. Appointing Chapman Lake Association members (or committees) specific responsibilities of learning how each agency works and who the key personnel are will help accomplish the goal of marketing the SLMP to these agencies.

8.3 Methodology

8.3.1 Signs

Monthly watershed "message boards" for 20 to 30 residents to display around the lake. The displayed messages should be coordinated effort by one person to change the signs frequently and get the messages out. It is suggested that signs be displayed for 6-8 months of the year. Signs should carry short (less than 6 word) slogans on how to protect water quality in the lake. They should be colorful and eye-catching. They should not be so obtrusive that they are offensive. Possibly, 18 X 24 inch standard real estate sized signs may be enough to convey the message. Consider producing a series of five or six unique signs, each with a different very short message. Changing the message each week during season may help to hold interest. Placed randomly around the lake encouraging such things as: "Watch your wake, Save your lake", "Shoreline speed kills, Save your lake", "Slow in shallow water, Save your lake", "Use No-Phos, Save your lake,"; "Out 200 or Idle, Save your lake", etc. Consider producing specialized, undated generic "know your lakes" handouts tailored and targeted for the following categories: sport fishermen, family boaters, skiers, personal watercraft users. (Note: Solicit input from enthusiasts of each group to assure practicality.)

8.3.2 Semi-permanent cards

Wallet size or 5 X 7 inch cards having targeted messages for different users, possibly a lake map on one side for handing out at all events or left for the taking in a waterproof container at the landing. Cards carrying different messages could all be left at the Marina or public landing and could be distributed during different months depending upon the message. Cards could be conveniently placed in holders attached to the signs mention in 8.3.1.

8.3.3 Annual events

Have an annual watershed event potentially shared County-wide with other lakes or in conjunction with another headliner event like a fish fry or County Fair. Offer conservation awards for residents and farmers who implement best management practices (BMP). Sponsor boater education courses. Enlist support of local agencies, i.e. Sheriff, health department, surveyor, planning department for a one-day "know your lakes" event in a centrally located facility; or, coordinated "know your lake day" in several locations throughout the county. Organize local events at Chapman Lakes to educate audiences about lake conservation and proper usage. An "Aquatic Day Camp" is currently being organized by the Chapman Lake Conservation Association. The day camp will be gear towards children aged 10-12 and will be implemented by local retired teachers. Aforementioned camp is scheduled to take place in August of 2007.

8.3.4 Newsletter

Continue existing newsletter articles on lake water quality and watershed actions. Mail the CLCA newsletter to new owners of property within the watershed. CLCA Scientific could have a water quality "slogan of the month" and then provide supporting data from their sampling to explain the slogan.

8.3.5 Website

Continue existing articles on lake water quality and watershed actions. Advertise the website on all printed material. Increase public and lake resident use of CLCA's website http://www.chapmanlake.com through the use of contests, rewards and similar incentives.

8.3.6 Drains to lake labels

Obtain "Drains to Lake" stickers or use stencils and appoint resident or hire contractor to install and maintain visibility. Appoint someone locally to install and maintain stickers.

8.3.7 Existing Media

Establish and cultivate print and broadcast media contacts. Utilize CLCA newsletter to print timely articles such as: March-April: No-phosphorus reminders. May-June-July: Boating/protect the lake environment, etc. March, July, September general mailing re: No-phosphorus, boating, lake environment, do's and don'ts. Consider local area "know your lakes" billboard educational campaign. Look into the possibility of creating an educational movie trailer to be played at local cinemas informing residents of lake issues.

8.3.8 Schools

Develop an education program about healthy lakes to implement at local schools. Parents will receive lake conservation messages through their children. Children are able to persuade parents to change their behaviors. Research existing information on how to develop a healthy Lakes curriculum and workbook. Encourage teachers to participate in Hoosier River Watch and report findings in your newsletter, website, and local newspapers. Help them publicize their results.

8.3.9 Other Ways of reaching people:

Develop Database for message distribution (separate from CLCA membership)
In-person meetings
Phone calls
E-mails

8.4 Resources for Implementation

8.4.1 EPA-IDEM 319 Funding

The Federal Clean Water Act Section 319(h) provides funding for various types of projects that work to reduce nonpoint source water pollution. Funds may be used to conduct assessments, develop and implement TMDLs and watershed management plans, provide technical assistance, demonstrate new technology and provide education and outreach. Organizations eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. A 40% (non-federal) in-kind or cash match of the total project cost must be provided. www.in.gov.idem

8.4.2 Kosciusko Community Foundation

The Kosciusko County Community Foundation directs grant money to reach a broad segment of the community, especially those citizens whose needs are not being met by existing services that are normally expected to be provided by private rather than government sources. Preferred projects include requests for seed money to realize innovative opportunities to meet needs in the community, stimulate and encourage additional funding, and those that promote cooperation and avoid duplication of efforts. However, it also directs grant money to help make a charitable organization more effective and efficient and better able to be self-sustaining and for one time projects or needs. It could fund the database development for instance. www.kcfoundation.org

8.4.3 Small grant from utilities and other corporations

The Environmental Challenge Fund is a not-for-profit corporation that provides employees of NiSource and its subsidiary companies the opportunity to demonstrate their commitment to their local environment. The Fund provides support for local natural resource and wildlife enhancement projects. These projects also create local educational and recreational opportunities. www.nisource.com

8.4.4 Private Foundations

There are many private foundations throughout the United States that fund projects of all types. Rather than try to identify them all here, JFNew has developed a grant matching program that will align your project goals with a potential foundation or agency. See www.jfnew.com

8.4.5 Indiana Lake Management Society (ILMS) small grant programs

ILMS serves all lakes and watersheds in Indiana with this small grants program (less than $5000). ILMS may fund 60% of the cost of the project. A 40% local match is required. Broad based support and multiple partners will be looked upon favorably in the review process. Proposed projects must directly improve, enhance, protect or preserve water quality. Eligible activities and programs that are part of a larger enhancement project will also be considered. Examples include water quality education, habitat improvement, filter strips, workshops, measuring pollutants in lakes and streams, and developing presentations or videos that teach good land management. www.indianalakes.org

8.4.6 LARE Grants

Grants are available on a competitive basis for several actions that can address the ecology and management of public lakes and their watersheds. Depending on your particular lake's needs, you may want to consider applying for funds for any of the following: 1) a preliminary lake study, 2) a comprehensive lake diagnostic study, 3) an engineering feasibility study of possible pollutant control measures, 4) a design study for a specific pollutant control measure, 5) construction of a particular pollutant control measure, 6) a management plan for the lake, or 7) a performance appraisal of a constructed pollutant control measure. The deadline to submit applications for these projects is January 31. Grants for approved projects will be awarded in the months of March (dredging and plant management) and July. www.in.gov/dnr/fishwild

8.4.7 Local newspaper and radio stations (public service ads)

Local media have time allocated for public service messages. While these time slots are generally not in prime time, the CLCA should take advantage of the time that is available to get the message out on lake water quality issues. This could be completed in conjunction with other area conservation organizations.

9.0 Measuring Success

Measuring stakeholders' success at achieving their goals and assessing progress towards realizing their vision for the Chapman lakes' watershed is a vital component of the plan. The following describes concrete milestones for stakeholders to reach, and tangible deliverables produced, while they work towards each goal. Interim measures or indicators of success, which will help stakeholders evaluate their progress towards their chosen goals, are listed in the following section as "milestones." Because several of the goals are long-term goals, regular monitoring is essential to ensure the actions stakeholders take are helping to achieve those goals. Water quality monitoring will allow stakeholders to make timely adjustments to their strategy if the monitoring results indicate such adjustments are needed; entities that either conduct water quality monitoring or serve as potential funding sources for implementing water quality monitoring and projects to improve water quality are included in section 9.2

9.1 Measuring attainment of goals

***Goal 1:* Improve the water quality in Big and Little Chapman Lake within ten years by lowering sediment and nutrient concentrations in the lakes and streams.**
Milestones:

- Select the SLMP goals to pursue and designate a person or persons responsible for implementing that goal.
- Create maps that include all existing woodlands and wetlands in the watershed, and on the same map, identify potential areas for woodland and wetland restoration.
- Create a second map showing existing livestock pastures.
- Appointment an individual to work with IDNR on identifying and implementing an appropriate Ecosystem Protection Zone in naturally shallow areas of the lakes.
- Establishment of an eco-zone.
- Complete beneficial sediment removal projects.
- Implement Aquatic Plant Management Plan.
- Install grassed waterway or control structure to eliminate erosion at headwaters of Crooked Creek.
- Implement projects to control sediment from Lozier Drain and Highland Drain.
- Select firm to complete a Feasibility study that determines the most efficient sewage treatment system available and securing State and/or Federal grants to pay for the study
- The Continuation of annual CLCA Scientific monitoring of the Chapman Lakes.
- A baseline secchi depth and phosphorous value that accounts for variation such as rainfall and strength of summer mean secchi depth (how many measurements were taken in a summer) must be calculated. The baseline secchi depth should be standardized so that only measurements taken between June 1st through September 30th are included in the calculation.

☐ ***Goal Attainment:* The goal will be attained when the average Secchi disc depth reading has at a minimum, stabilized, and ideally showing increasing water clarity trends from year to year.**

Goal 2: **Consistently meet the state standards for concentration of E. coli bacteria within the Chapman Lakes and within the streams that flow into lakes.**

Milestones:

- Appointment of a shoreline property owner as the local expert to develop a rapport with the local health inspector that others can go to with questions without fear of having to overhaul their system.
- Publication of contact information for local expert in CLCA newsletter and on website.
- Delivery of presentation by a septic hauler on system maintenance and repairs.
- Delivery of presentation by Health Department on alternative septic system designs.
- Distribution of education material to watershed landowners regarding regular cleaning of septic tanks.
- Distribution of educational material to watershed landowners on proper methods for disposing of pet or other animal waste.
- Development of incentives for residents to clean their septic tanks.
- Continued regular sampling for *E. coli* by CLCA Scientific.

☐ ***Goal attainment:*** **The goal is continuously attained when the *E. coli* concentrations in Big Chapman Lake, Little Chapman Lake, and the watershed streams meet the state standard (less than 235 colonies/ 100 ml) throughout the year.**

Goal 3: Educate a minimum of 50 percent of the landowners within the Chapman Lakes Watershed on at least one of the water quality issues facing the Chapman Lakes and have at least 50 percent of those landowners implement one water quality improvement project within the next 5 years.

Milestones:

- Publication of water quality improvement projects in the CLCA newsletters and on website.
- Maintain highly visible sign at the public launch regarding boating rules invasive species.
- Development of printed material (small cards) on nutrient sources and effects and other water quality issues and successful distribution.
- Development of small signs advertising water quality issues and the successful distribution to cooperating landowners to display them.
- The successful use of local news media (radio and television) to get the message out.
- Advertisement of property value increases on Indiana lakes for which a sewer has been installed in the past 20 years (Webster, Wawasee, Witmer, Big Turkey, Oliver, and Lake-of-the-Woods).
- Conduct a survey to measure changes in awareness and behavior response to education campaigns.

☐ ***Goal attainment:*** **The goal is attained when lot owners around the lake begin implementing small projects to improve water quality and when the majority of boaters obey the boating laws voluntarily or when 50% of respondents to a landowner survey indicate that they have taken some action to improve water quality or are voluntarily observing boat laws..**

Goal 4: Successfully manage Chapman Lakes use for the enjoyment of all users.

Milestones:

- Completion of research regarding watercraft carrying capacity issues and reporting of results to Task Force or CLCA for subsequent action.
- Completion of residential survey periodically to see how lake residents view lake use.
- Staying current on all requests for public piers and funneling and maintaining a record of exemptions and allowances, which should be shared at CLCA meetings.
- Appointment of an individual responsible for communicating with commissioners regarding lake districting issues.
- Attendance of any open planning and zoning commissioner meetings where work is being proposed within a lake district.
- Restriction of visitor parking to public boat launch and petitioning of the IDNR to limit fishing tournaments if research indicates that Chapman Lakes are at or near carrying capacity.
- Appointing volunteer lake property owner as sheriff contact.
- Establishing a volunteer deputy program.
- Obtaining a designated enforcement boat through raffle or donation.
- Enforcement boat moored on a pier within sight of the public launch throughout the boating season or being used for active patrolling.
- Dissemination of education and information by deputies.

☐ ***Goal attainment:*** **The goal has been attained when the carrying capacity of the Chapman Lakes have been calculated and measures to limit use of the lake to the calculated levels have been implemented. Additionally, a portion of the goal includes the successful establishment of the volunteer deputy program and enforcement boat that are actively working to enforce current boating laws.**

Goal 5: Successfully manage nuisance species of plants and animals on Big and Little Chapman Lakes.

Milestones:

- Successful implementation of Aquatic Plant Management Plan.
- Establishment of annual aquatic plant surveys that follow IDRN procedures and protocols.
- Successful investigation and program development to census zebra mussel population.
- Establishment of survey and control program for Canada goose and Mute swan populations.
- CLCA Scientific overseeing annual invasive species control program.
- Annual report recommendations to CLCA Board on invasive species control.

☐ ***Goal attainment:*** **The goal has been attained when aquatic plants meet the goals detailed in the Chapman Lakes plant management plan and/or other management documents comprise less than 5 percent of the aquatic plant community, zebra mussels populations are documented, and geese and mute swan populations are held in check.**

Goal 6: Successfully manage the water level on Big and Little Chapman Lakes.

Milestones:
- Funding is obtained or approved to purchase gage for levee
- Appointed representative purchases and installs the gage with IDNR assistance
- Completion of annual levee inspection and reporting of status to CLCA
- Appointment of a lake representative to learn about the new levee and perform annual inspections with the IDNR representative.

☐ ***Goal attainment:*** **The goal is attained when the gauge has been purchased and installed and the appointed lake representative has completed the annual inspection of the levee.**

Goal 7: Maintain the Strategic Lakes Management Plan as the primary guide for improving the water quality and the recreational resources within and around the Chapman Lakes.

Milestones
- Appointment of an individual to be responsible for implementing the plan and updating CLCA with changing goals and actions within the plan.
- Using CLCA Scientific surveys to fully update the plan annually.
- CLCA to appoint new task force to update the plan every five years with new goals and action items from annual meetings and community surveys.
- Summary of completed actions for the previous year and proposed actions for the upcoming year presented at annual meeting with stakeholders.

☐ ***Goal attainment*****: The goal is attained when 70% of the identified actions are implemented. Alternately, the goal is attained annually when the plan has been utilized by the sponsor and updated on a regular schedule with public input.**

9.2 Sources of support

9.2.1 Professional monitoring

9.2.1.1 IDEM Clean Lakes Program

The Indiana Clean Lakes Program was created in 1989 as a program within the Indiana Department of Environmental Management's (IDEM) Office of Water Management. The program is administered through a grant to Indiana University's School of Public and Environmental Affairs (SPEA) in Bloomington. The Indiana Clean Lakes Program is a comprehensive, statewide public lake management program having five components:

1. Public information and education:
   a. Produce and distribute the quarterly *Water Column* newsletter
   b. Sponsor the annual Indiana Lake Management Conference
   c. Prepare lake assessment reports
   d. Conduct training and informational workshops

2. Technical assistance
    a. Assist lake association with interpreting water quality data
    b. attend lake association meetings
    c. present programs to lake associations
3. Volunteer lake monitoring
    a. citizen volunteers monitor water transparency on 80 Indiana lakes
    b. volunteers in an expanded program collect monthly samples for total phosphorus and chlorophyll *a* analysis
4. Lake water quality assessment
    a. conduct routine assessments of water quality on Indiana lakes
    b. identify regional and/or temporal patterns in lake data
    c. identify lake conditions that warrant further attention
5. Coordination with other state and federal lake programs
    a. work with other state and federal agencies to coordinate efforts and enhance the protection of Indiana lakes

9.2.1.2 IDNR Fisheries management

The IDNR Fish and Wildlife division should be contact to facilitate the attainment of goal 5. Useful information on nuisance Canada Goose Management is available at: http://www.in.gov/dnr/fishwild/Nuisance-Wildlife.html.

9.2.1.3 United States Department of Agriculture – National Agriculture Statistics Service/ Purdue agricultural statistics

County level information and statistics regarding crops and plants, demographics, economics, environmental concerns, livestock and animal populations are available at: http://www.nass.usda.gov/Statistics_by_State/Indiana/index.asp.

9.2.1.4 Kosciusko County Health Department

The mission of the Kosciusko County Health Department it to promote, protect, and improve the public health of all Kosciusko County citizens and visitors in a cost-effective and servant-like manner.

The Environmental Scientists are responsible for enforcing all State and local public health laws. Their activities include investigating disease outbreaks, regulating on-site well and septic system installations, public pool and beach inspections, water sampling and complaint investigations. The Septic Inspector for Kosciusko County, whom should be contacted to attain goal 1, is Neal Brown, Septic Inspector for Kosciusko Health Department (574-372-2349).

9.2.2 Volunteer monitoring

9.2.2.1 IDNR Riverwatch program

Hoosier Riverwatch is a state-sponsored water quality monitoring initiative. The program was started in 1994 to increase public awareness of water quality issues and concerns by training volunteers to monitor stream water quality. Hoosier Riverwatch collaborates with agencies and volunteers to:

- Provide education and training on watersheds and the relationship between land use and water quality.
- Increase public involvement in water quality issues.
- Promote responsible stewardship of water resources.
- Provide water quality information to citizens and government officials working to protect Indiana’s rivers and streams.

Hoosier Riverwatch is sponsored by the Indiana Department of Natural Resources - Division of Fish and Wildlife. Funding is provided in part by the Federal Sport Fish Restoration Fund.

9.2.2.2 CLCA Scientific

The “CLCA Scientific” water quality monitoring program started in 2005 and should provide invaluable data. This volunteer program, headed by a qualified scientist with a trained volunteer staff has already identified “spot” area in both lakes where specific monitoring is needed, and has expanded locations for Secchi disk measurements to broaden information availability. Trends established by regularly scheduled chemical analysis are the key to the program’s ongoing management.

"CLCA Scientific", an on-going water quality testing program for the Chapman Lakes. The CLCA program is a continuing water chemistry testing program utilizing its own laboratory for sample processing. Len Draving, a 40-year chemistry instructor and biologist, was appointed the first volunteer head of the program and currently serves in this position.

CLCA's board of directors has authorized purchase of test kits and other equipment for sample processing so sampling can begin immediately, and has funded the program through 2007. Testing will include sampling and processing for bacteria, dissolved oxygen, solids, and nutrients, among others. The testing is critical in constantly tracking the health of the lakes.

10: Plan Evaluation and Update

10.1 Responsibility for evaluation

The Chapman Lake Conservation Association Governing Board will be responsible for evaluating the Watershed Management Plan at the time that this plan was written, the following individuals served on the governing board.

Chapman Lakes Conservation Association Governing Board
Tom Ross, President
Dan Lee, Vice-President
Bill Curts, Director and Chairman of the Board
Fran Nichols, Secretary
Amanda Lee, Treasurer

10.2 Timeline for implementation, evaluation, and adaptation

Implementation of project identified in this plan will be prioritized by the CLCA and implemented over the next five years. The Strategic Lakes Management Plan will be reviewed annually and accomplished milestones will be recorded. Every five years the SLMP will be reviewed and attained goals will be marked off the list. Every 10 years the entire Strategic Lakes Management Plan will be reviewed and updated to match current needs and issues.

10.3 Contact Information

Tom Ross, President
Chapman Lakes Conservation Association, Inc.
P.O. Box 776
Warsaw, IN 46581-0776

10.4 Distribution list

Tom Ross, Executive Committee, Chapman Lake Strategic Management Plan
Bill Magurany, Executive Committee, Chapman Lake Strategic Management Plan
Howard Woodward, Jr., Executive Committee, Chapman Lake Strategic Management Plan
Mark Granger, Executive Committee, Chapman Lake Strategic Management Plan
Dan Lee, Chapman Lakes Conservative Association/ Chapman Lakes Foundation
Sam St. Clair, District Conservationist, SWCD
Robert Stevens, watershed property owner
Ed Enders, representing fishing enthusiasts
Jed Pearson, IDNR, fisheries biologist
Dick Kemper, Kosciusko County Surveyor
Rich Dunbar, IDNR, Div. of Nature Preserves
Lt. John Sullivan, IDNR, Div. of Law Enforcement
Linda Schmidt, Indiana Department of Environmental Management
Chad Watts, The Nature Conservancy
Sgt. Chris McKeand, Kosciusko County Sheriff's Department
Gwen White, IDNR Department of Fish and Wildlife
Steve Parker

Greg Hall, CLF President
John Hall
Emily Cowan
Leonard Draving
Coral Amspaugh-Topolski, Island Park Property Owners Assn.
Vere Shenefield
Kosciusko County REMC
NIPSCO
American Electric Power

11.0 Literature Search

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12.0 Glossary and Acronyms

ACOE - United States Army Corps of Engineers –regulates all fill activities below the ordinary high water mark of a lake or stream and wetlands adjacent to those waters.

ASCS – Agricultural Stabilization and Conservation Service now called the Farm Services Agency (FSA)

CLF – Chapman Lakes Foundation – A 501(c)(3) organization at Chapman Lake

CLCA – Chapman Lakes Conservation Association –
Hydrologic Unit Code (HUC) – The numeric watershed label attached to a drainage area defined by topography.

IDEM - Indiana Department of Environmental Management

IDNR – Indiana Department of Natural Resources

NRCS – Natural Resource Conservation Service

SWCD – Soil and Water Conservation District

SPEA - Indiana University's School of Public and Environmental Affairs

USDA – United States Department of Agriculture

USEPA – United States Environmental Protection Agency

APPENDIX A:

CLCA Scientific Data Report and Analysis

CLCA Scientific
General Commentary on Lake Water Quality Analysis

Prior to 2005, only intermittent water quality testing data was maintained by Indiana State sources for Big Chapman Lake, and no regular testing was done for Little Chapman Lake at all. As a result, only single annual figures for the lakes are available.

In 2005, Chapman Lakes Conservation Association, Inc., through its "CLCA Scientific" project, began regular weekly and bi-monthly testing of both lakes for Secchi depth transparency, soluble reactive phosphorus, total phosphorus, pH, alkalinity, conductivity, nitrate nitrogen, ammonia nitrogen, oxygen saturation at 5 foot intervals, and dissolved oxygen at five foot intervals. In addition, testing at watershed drains into the lakes and at various other lake locations for bacteria (such as e.coli) is undertaken on a regular basis when ice is not present.

A general decline in water transparency in both lakes is evident in comparisons beginning in 1998. Multiple tests by CLCA Scientific beginning in 2005 indicate that decline began to level off by the end of 2005, and was improving by season end 2006.

It is important to remember that cultural eutrophication (land development and use of the lakes by humans) is the major cause of a rapid unnatural (or increased decline) of a lake's water quality. Boating use of the Chapman Lakes, by actual count, has more than quadrupled in the past five years, including a 15-percent increase in use of the public boat ramp 2005 through 2006. The number of boats at piers on both lakes grew from 1,089 in 2005 to 1,172 in 2006.

While the very slow natural aging process of any lake cannot be stopped, knowledge of water quality and the impact of boating activity can aid in the implementation of programs that will alleviate the more rapid decline caused by lake over use i.e. Cultural Eutrophication.

MONITORING PROGRAM
SUMMER 2005

In the summer of 2005 I was contacted by Dan Lee to set up a lake monitoring program for Big and Little Chapman Lakes. The initial intent was to start a basic monitoring program that a moderate budget could support and maintain over a period of three years. After this period of time and assuming the gathered information was useful and reliable, the program could be expanded, with additional parameters and sampling sites. It was decided that as much as possible we would follow the 2000 Chapman Lake Diagnostic Study in regards to the parameters tested and the sampling site locations. Other than myself, three other individuals; Rick Barringer,Bill Magurany, and Jim Doyle donated a great deal of time and effort to make our monitoring program a success. The program could not have been done without them.

INLET DRAIN SAMPLING

The sampling locations consisted of the following:

Site 1: Lozier's Creek
Site 2: Arrowhesd Park Drain
Site 3: Crooked Creek
Site 4: Island Park Drain (Because of man-power, this site was not included)
Site 5: Outlet (Dam)
Site 6: Highland Park Drain

Our first of three samples was collected on Aug. 3, 2005 and our last one was collected on August 31, 2005. At this time, there was no flow of water and we stopped sampling in the inlets. As you all know, we had a rather dry summer. Even the rains that did occur after August 31, 2005 did not produce a flow. Only one test was done at the dam outlet, since no water flowed over the dam after our first sample of 8-3-05.

The collected samples were obtained early in the mornings, taken to Len Dravings place, and run. We analyzed the samples for the following parameters: conductivity, ammonia, nitrate/nitrite, total phosphorus, soluble phosphorus (ortho), pH, total dissolved solids, and E.-coli.. The Tests for conductivity, pH, and total dissolved solids were conducted with meters. The tests for ammonia, nitrate/nitrite, total phosphorus and soluble phosphorus were conducted with Hach test kits. The E-coli test was conducted using Hachs membrane filtration system and the bacteria cultured on plates containing m-ColiBlue24 Broth.

RESULTS AND DISCUSSION

Since multiple measurements are more meaningful than single measurements, discussion will be related to Table 1, which represents the mean values, for each parameter, at each of the testing sites.

Ph values in the Chapman lakes inlet are well within the range of 6 - 9 units. Conductivity values were elevated at all inlets as compared to the levels reported in the diagnostic report of 2000. But, as indicated in the diagnostic report, ionized particles and other charged particles are more likely to dissolve in slow moving water, resulting in an increase in concentration. We had a very dry season.

Nitrate/nitrite nitrogen levels were much lower at all sites, but ammonia nitrogen, total phosphorous and soluble phosphorus levels were all elevated as compared to the 2000 study. At all sites, soluble phosphorus levels were about one half that of the total phosphorus levels, except at Losier's Creek, which were equal.

Losier's Creek and the Outlet had levels of E-coli that would be in an acceptable range. Crooked Creek and Highland Park displayed levels that would indicate concern.

Inlet stream sampling

TABLE 1 Chemical Character and Concentration Data from the Chapman Lakes' Inlets and Outlets. (mean values)

	Losier's Creek	Arrowhead Park	Crooked Creek	* Outlet-Dam	Highland Park
Conductivity (umhos)	712	704	586	766	1344
Ammonia (mg/L)	0.66	0.50	0.78	0.16	0.67
Nitrate/Nitrite (mg/L)	0.051	0.26	0.23	2.64	0.20
Total Phosphorus (mg/L)	0.16	0.28	0.15	0.26	0.12
Soluble Phosphorus (mg/L)	0.16	0.104	0.11	0.11	0.05
pH	7.78	7.66	7.97	8.07	7.54
Total Dissolved Solids (mg/L)	347	357	303	384	668
E-coli (col./100 ml)	167	290	517	160	427

* Only one reading was taken at this site since water stopped flowing over the dam after 8-3-05.

Inlet sampling

I firmly believe that the low flow of water in the inlets, during the time of sampling, played a large roll in the data we obtained The low flow of water in the inlets did not discharge an excessive amount of nutrients into the lakes.

IN-LAKE SAMPLING

Water samples were collected on five different dates from the surface waters (epilimnion) and on two different dates from the bottom waters (hypolimnion) at the deepest parts of Big and Little Chapman Lakes. The bottom waters were sampled only after we were able to borrow the use of a temperature/dissolved oxygen meter from LaGrange County Soil and Water Division. The parameters for both lakes included alkalinity, conductivity, pH, sechi disc, total phosphorus, soluble reactive phosphorous, nitrate nitrogen, ammonia nitrogen, dissolved oxygen, and oxygen saturation at five feet.

Results

Results of the sampling of BIG CHAPMANS lake waters are included in Table 2 (mean values) and Figure 1 (temp/dissolved oxygen profile). Results of Little Chapmans lake waters are included in Table 3 (mean values) and Figure 2 (temp/dissolve oxygen profile).

Once a dissolved oxygen/temperature meter was obtained, we were able to do a profile for each lake at its deepest place. One of waters unique physical properties is density. Water becomes more dense as its temperature is lowered (like most liquid substances). However, once four degrees centigrade is reached, water has reached its highest density and any further reduction in temperature causes the water to become less dense. This is why ice floats at a temperature of Zero degree centigrade or less. This enables water in most lakes to turn over and also to form stratified regions. Big and Little Chapman Lakes were stratified on 9-17-05, which was the day the profile was done. The upper layer (epilimnetic) and now the bottom layer (hypolimnetic) could be tested.

Since the State of Indiana has no standards for fresh-water lakes, the data is difficult to assess. The State of Indiana does have what is called the Indiana Trophic State Index (ISTI) which uses ten different water quality parameters to calculate a score (Table 4). Each parameter is assigned a point value from a range of points. The points from the ten parameters are added to give a total score. Based on the total points, the lakes are given a water quality classification (age). Since our study tested only six of the states parameters, we cannot give a total score. We can only use the point values for each parameter we tested and compare to the points of parameters assigned in previous years.

Sampling of E.-coli was done on two different dates (Table 5). The results of E.-coli did not exceed the State standard of 235 col/100 ml in any one sample in a thirty day period.

Summation

The data collected in the waters of Big and Little Chapman Lakes, the drains which discharge to the lakes from the watershed, and the water which leaves the lakes (dam), was greatly influenced by the following:

1. The lakes and the watershed experienced a very dry season.

2. The monitoring program started in late summer after melting snow and Spring rains.

3. The flow from the four drainage sites virtually stopped flowing about August 31, 2005.

4. Rains after August 31, 2005 produced a very low flow.

5. No water was flowing over the dam at the outlet after August, 2005.

The two Chapman lakes, in the summer of 2005, were analogous to a pot of soup, simmering slowly on a hot-plate. Few nutrients were being added to the pot, the nutrients are inter-reacting in the pot, and no nutrients are leaving the pot. The water is evaporating and the nutrients are being concentrated. The soup, with these conditions, should taste good.

IN-LAKE SAMPLING

Table 2. Water Quality Characteristics of Big Chapman Lake, 2005. (mean values)

PARAMETER	EPILIMNETIC SAMPLE	HYPOLIMNETIC SAMPLE	* INDIANA TSI POINTS (based on mean values)
Alkalinity (mg/L)	166	240	----
Conductivity (umhos)	386	448	----
pH	8.31	7.52	----
Secchi Disc (m)	2.49	----	0
Total Phosphorus (mg/L)	0.064	0.98	4
Soluble Reactive P (mg/L)	0.023	0.056	2
Nitrate Nitrogen (mg/L)	0.012	0.01	0
Ammonia Nitrogen (mg/L)	0.134	1.80	3
Oxygen Sat. @ 5 ft. (%)	100.1	----	0
Dissolved Oxygen @ 5 ft. (mg/L)	8.1	----	----
Chlorophyll=a (ug/L)	Unable to do		

*Today's ITSI uses ten different water quality parameters to calculate a score. We would have to test for the following parameters:

1. Organic Nitrogen
2. Dissolved Oxygen: As percent of measured water column with at least 0.1 mg/L of dissolved oxygen.
3. Light Transmission (Photocell): Percent of light transmission at a depth of three feet.
4. Total Plankton per liter of water sampled from a single vertical tow between the 1 % light level and the surface.

IN-LAKE SAMPLING

Table 3. Water Quality Characteristics of LITTLE Chapman Lake, 2005. (mean values)

PARAMETER	EPILIMNETIC SAMPLE	HYPOLIMNETIC SAMPLE	* INDIANA TSI POINTS (based on mean values)
Alkalinity (mg/L)	149	250	----
Conductivity (umhos)	515	537	----
pH	8.37	7.02	----
Secchi Disc (m)	1.11	----	6
Total Phosphorus (mg/L)	0.12	0.87	4
Soluble Reactive P (mg/L)	0.022	o.55	4
Nitrate Nitrogen (mg/L)	0.026	0.00	0
Ammonia Nitrogen (mg/L)	0.22	3.25	4
Oxygen Sat. @ 5 ft. (%)	97.1	----	0
Dissolved Oxygen @ 5 ft. (mg/L)	7.9	----	----
Chlorophyll=a (ug/L)	Unable to do		

*Today's ITSI uses ten different water quality parameters to calculate a score. We would have to test for the following parameters:

1. Organic Nitrogen
2. Dissolved Oxygen: As percent of measured water column with at least 0.1 mg/L of dissolved oxygen.
3. Light Transmission (Photocell): Percent of light transmission at a depth of three feet.
4. Total Plankton per liter of water sampled from a single vertical tow between the 1 % light level and the surface.

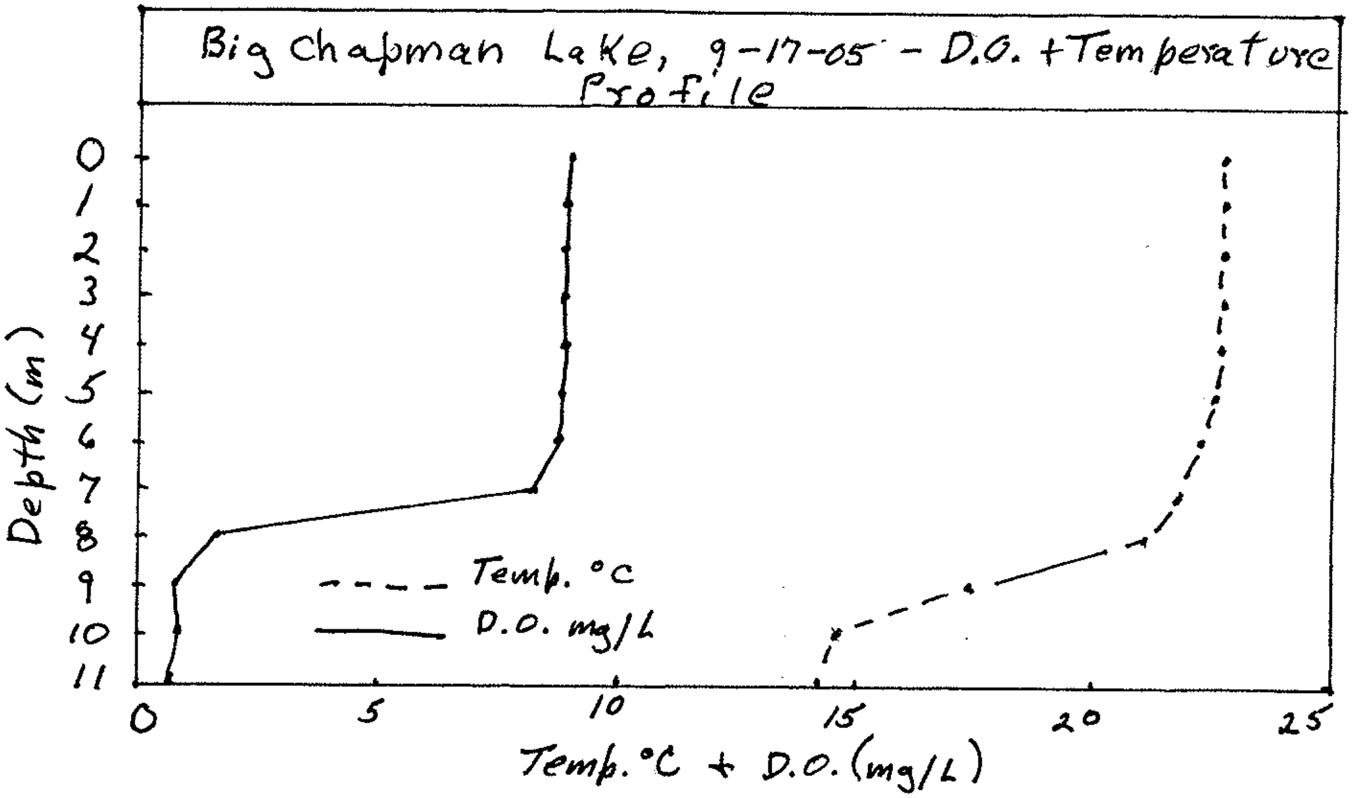

Figure 1 Dissolved oxygen and Temperature profile for Big Chapman Lake

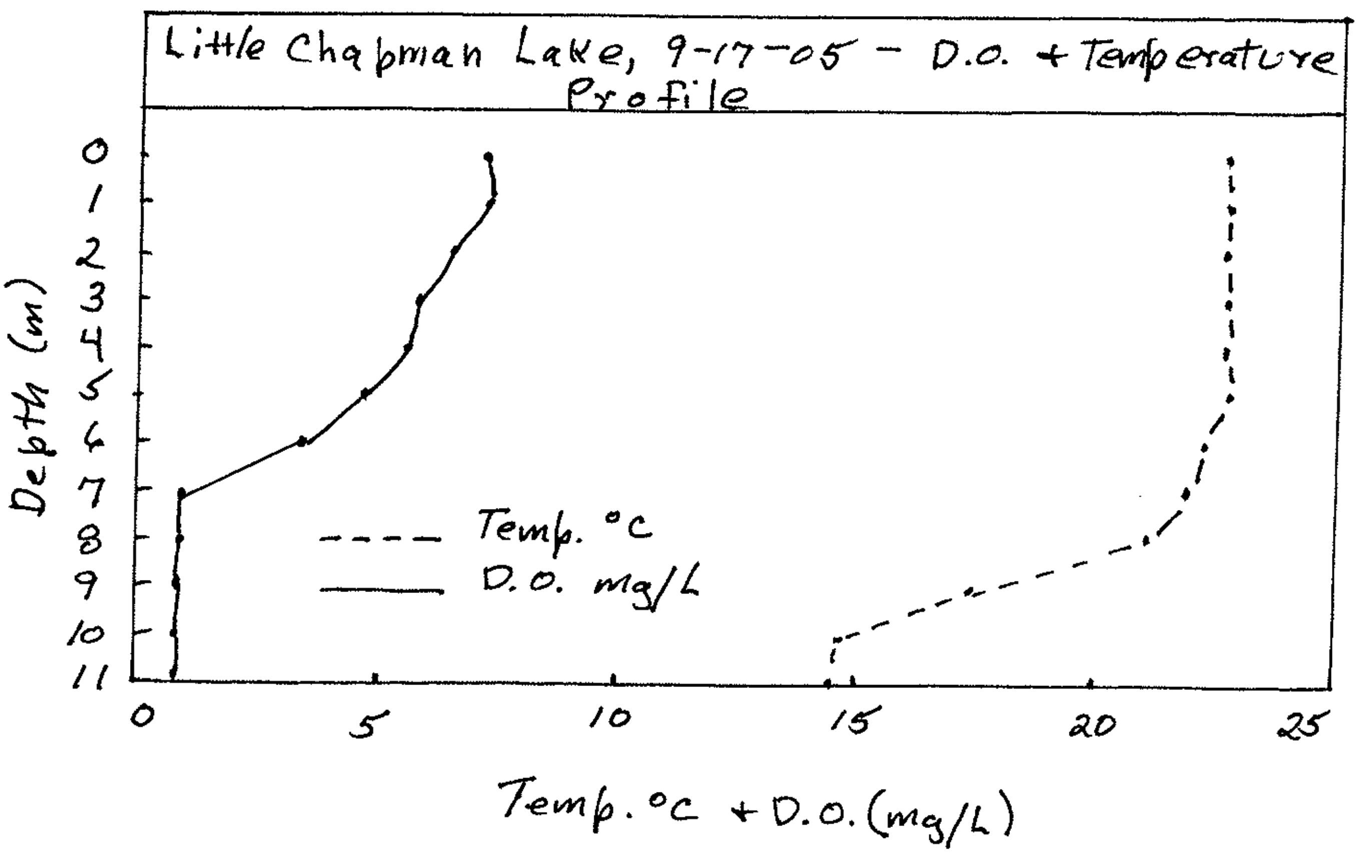

Figure 2 Dissolved oxygen and Temperature Profile for Little Chapman Lake

Table 4 THE INDIANA TROPHIC STATE INDEX

Parameter and Range	Eutrophy Points
I. Total Phosphorous *(ppm)	
A. At least 0.03	1
B. 0.04 to 0.05	2
C, 0.06 To 0.19	3
D. 0.2 to 0.99	4
E. 1.0 or more	5
II. Soluble Phosphorous (ppm)	
A. At least 0.03	1
B. 0.04 to 0.05	2
C. 0.06 to 0.19	3
D. 0.2 to 0.99	4
E. 1.0 or more	5
III. Organic Nitrogen (ppm)	
A. At least 0.5	1
B. 0.6 to 0.8	2
C. 0.9 to 1.9	3
D. 2.0 or more	4
IV. Nitrate (ppm)	
A. At least 0.3	1
B. 0.4 to 0.8	2
C. 0.9 to 1.9	3
D. 2.0 or more	4
V. Ammonia (ppm)	
A. At least o.3	1
B. 0.4 to 0.5	2
C. 0.6 to 0.9	3
D. 1.0 or more	4
VI. Dissolved Oxygen: Percent Saturation at 5 feet from surface	
A. 114% or less	0
B. 115% to 119%	1
C. 120% to 129%	2
D. 130% to 149%	3
E. 150% or more	4
VII. Dissolved Oxygen: Percent of measured water column with least 0.1 ppm dissolved oxygen	
A. 28% or less	4
B. 29% to 49%	3
C. 50% to 65%	2
D. 66% to 75%	1
E. 76% to 100%	0
VIII. Light Penetration (Secchi Disk)	
A. Five feet or under	6
IX. Light Transmission (photocell): Percent of light transmission at a depth of 3 feet	
A. 0 to 30%	4
B. 31% to 50%	3
C. 51% to 70%	2
D. 71% and up	0

X Total Plankton per liter of water sampled from a single vertical tow between the 1% light level and the surface:

A.	less than 3,000 organisms/L	0
B.	3,000 - 6,000 organisms /L	1
C.	6,001 - 16,000 organisms/L	2
D.	16,001 - 26,000 organisms/L	3
E.	26,001 - 36,000 organisms/L	4
F.	36,001 - 60,000 organisms/L	5
G.	60,001 - 95,000 organisms/L	10
H.	95,001 - 150,000 organisms/L	15
I.	150,001 - 500,000 organisms/L	20
J.	greater than 500,000 organisms/L	25
K.	Blue-Green Dominance: additional points	10

* ppm is the same as mg/L

Values for each water quality parameter are totaled to obtain an ITSI score. Based on this score, lakes are then placed into one of five categories.

TSI Total	Water Quality Classification
0 - 15	Oligotrophic
16 - 31	Mesotrophic
32 - 46	Eutrophic
47 - 75	Hypereutrophic
*	Dystrophic

Four of these categories correspond to the qualitative lake productivity categories. The fifth category, dystrophic, is for lakes that possess high nutrient concentration but have limited rooted plant and algal productivity

IN-LAKE SAMPLING
(E-coli)

Table 5

Big Chapman Lake

8-29-05

1. Swimming area in front of Dan Lee's house. 20 colonies/100 ml.
2. Small island on south side of lake (pontoon boats gather here and people swim). 90 colonies/100 ml.
3. Blue pipe in channel on west side. Septic suspect. 15 colonies/100 ml.

Little Chapman Lake

9-6-05

1. Swim platform (raft) in fron of Loziers. 0 colonies/100 ml.
2. East channel at the North end of Little Chapman. 130 colonies/100 ml.
3. West channel at the North end of Little Chapman. 160 colonies/100 ml.

SWIM, BUT DON'T DRINK THE WATER!!!!

Supporting Data

INLET STREAM SAMPLING

Table _____

Site 1 Lozier's Creek

Sample Date	*10-12-00	8-3-05	8-17-05	8-31-05
PARAMETER				
Conductivity (umhos)	650	732	731	673
Ammonia (mg/l)	<0.40	0.48	1.10	0.40
Natrate/Nitrite (mg/l)	5.0	0.09	0.044	0.02
Total Phosphorus (mg/l)	0.03	did not do	0.113	0.21
Soluble Phosphorus (mg/l	<0.02	0.33	0.01	0.15
pH	8.03	8.08	7.58	7.67
Total Dissolved Solids (mg/l)	did not do	347	360	333
E-coli (col/100ml)	100	300	90	110

*2000 Diagnostic Study

We stopped monitoring the site after 8-31-05 since there was no water flow. (dry season)

INLET STREAM SAMPLING

Table ____

Site 2 Arrowhead Park Drain

Sample Date	*10-12-00	8-3-05	8-17-05	8-31-05
PARAMETER				
Conductivity (umhos)	670	764	609	738
Ammonia (mg/l)	<0.10	0.80	0.40	0.30
Natrate/Nitrite (mg/l)	4.2	0.00	0.26	0.00
Total Phosphorus (mg/l)	0.03	0.113	0.13	0.60
Soluble Phosphorus (mg/l	0.02	0.036	0.045	0.23
pH	8.02	7.86	7.78	7.35
Total Dissolved Solids (mg/l)	did not do	384	329	357
E-coli (col/100ml)	8300	100	260	510

*2000 Diagnostic Study

We stopped monitoring the site after 8-31-05 since there was no water flow. (dry season)

INLET STREAM SAMPLING

Table _____

Site 3 Crooked Creek

Sample Date	*10-12-00	8-3-05	8-17-05	8-31-05
PARAMETER				
Conductivity (umhos)	670	604	609	545
Ammonia (mg/l)	<0.10	1.6	0.133	0.60
Natrate/Nitrite (mg/l)	3.2	0.40	0.26	0.02
Total Phosphorus (mg/l)	0.05	0.03	0.113	0.31
Soluble Phosphorus (mg/l	0.03	0.016	0.05	0.25
pH	8.12	8.63	7.78	7.49
Total Dissolved Solids (mg/l)	did not do	305	329	276
E-coli (col/100ml)	100	450	260	840

*2000 Diagnostic Study

We stopped monitoring the site after 8-31-05 since there was no water flow. (dry season)

Inlet stream sampling form

Table _____

Site 6 Highland Park Drain

Sample Date	*10-12-00	8-3-05	8-17-05	8-31-05
PARAMETER				
Conductivity (umhos)	720	1437	1280	1315
Ammonia (mg/l)	<0.10	0.06	1.4	0.56
Nitrate/Nitrite (mg/l)	0.74	0.35	0.22	0.02
Total Phosphorus (mg/l)	0.04	0.21	0.086	0.053
Soluble Phosphorus (mg/l	0.04	0.06	0.05	0.026
pH	7.95	7.76	7.31	7.56
Total Dissolved Solids (mg/l)	-----	715	645	643
E-coli (col/100ml)	420	680	570	30

*2000 Diagnostic study

We stopped monitoring the site after 8-31-05 since there was no water flow. (dry season)

Inlet stream sampling

Table _____

Site 5 Outlet-Dam

Sample Date	*10-12-00	8-3-05	8-17-05	8-31-05
PARAMETER				
Conductivity (umhos)	740	766	No flow	No flow
Ammonia (mg/l)	<0.10	0.16	No flow	No flow
Natrate/Nitrite (mg/l)	0.74	2.64	No flow	No flow
Total Phosphorus (mg/l)	0.05	0.26	No flow	No flow
Soluble Phosphorus (mg/l	<0.02	0.11	No flow	No flow
pH	7.59	8.07	No flow	No flow
Total Dissolved Solids (mg/l)	did not do	384	No flow	No flow
E-coli (col/100ml)	100	160	No flow	No flow

*2000 Diagnostic Study

We stopped monitoring the site after 8-17-05 since there was no water flow. (dry season)

Supporting Data

IN-LAKE SAMPLING

Table ____

Little Chapman Lake

Date 8-07-2000 Diagnostic Study

PARAMETERS	EPILIMNETIC SAMPLE	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	126	182
Conductivity (umhos)	368.8	402.1
pH	8.6	7.5
Secchi Disc (m)	1.3	---
Total Phosphorus (mg/L)	0.079	0.217
Soluble Reactive P (mg/L)	0.013	0.173
Nitrate Nitrogen (mg/L)	0.013	0.013
Ammonia Nitrogen (mg/L)	0.018	1.251
Oxygen Sat. @ 5 ft. (%)	102	----
Temperature @ 5 ft. (C)	?	
Dissolved Oxygen @ 5 ft. (mg/L)	?	
Chlorophyll-a (ug/L)	6.56	

IN-LAKE SAMPLING

Table _____

Little Chapman Lake

Date 8-11-05

PARAMETERS	EPILIMNETIC SAMPLE 5' or 1.5m	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	125	---
Conductivity (umhos)	---	---
pH	8.0	---
Secchi Disc (m)	1.0	---
Total Phosphorus (mg/L)	0.13	---
Soluble Reactive P (mg/L)	0.007	---
Nitrate Nitrogen (mg/L)	too low to measure	---
Ammonia Nitrogen (mg/L)	0.24	---
Oxygen Sat. @ 5 ft. (%)	92.1	---
Temperature @ 5 ft. (C)	28.2	
Dissolved Oxygen @ 5 ft. (mg/L)	7.o	
Chlorophyll-a (ug/L)	Un-able to do	

No hypolimnetic reading were obtained because we could not, at this time, do a dissolved oxygen/temperature profile. We must have a dissolved oxygen/temperature meter with a fifty foot cable.

IN-LAKE SAMPLING

Table _____

Little Chapman Lake

Date 8-24-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	140	---
Conductivity (umhos)	453	---
pH	8.49	---
Secchi Disc (m)	1.1	---
Total Phosphorus (mg/L)	0.054	---
Soluble Reactive P (mg/L)	not measurable	---
Nitrate Nitrogen (mg/L)	0.01	---
Ammonia Nitrogen (mg/L)	0.2	---
Oxygen Sat. @ 5 ft. (%)	88.6	---
Temperature @ 5 ft. (C)	25.4	
Dissolved Oxygen @ 5 ft. (mg/L)	7.0	
Chlorophyll-a (ug/L)	Un-able to do	

No hypolimnetic reading were obtained because we could not, at this time, do a dissolved oxygen/temperature profile. We must have a dissolved oxygen/temperature meter with a fifty foot cable.

IN-LAKE SAMPLING

Table _____

Little Chapman Lake

Date 9-7-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	160	---
Conductivity (umhos)	520	---
pH	8.59	---
Secchi Disc (m)	1.25	---
Total Phosphorus (mg/L)	0.21	---
Soluble Reactive P (mg/L)	0.026	---
Nitrate Nitrogen (mg/L)	0.02	---
Ammonia Nitrogen (mg/L)	0.15	---
Oxygen Sat. @ 5 ft. (%)	98.8	---
Temperature @ 5 ft. (C)	24.5	
Dissolved Oxygen @ 5 ft. (mg/L)	8.0	
Chlorophyll-a (ug/L)	Un-able to do	

No hypolimnetic reading were obtained because we could not, at this time, do a dissolved oxygen/temperature profile. We must have a dissolved oxygen/temperature meter with a fifty foot cable.

IN-LAKE SAMPLING

Table _____

Little Chapman Lake

Date 9-21-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE 26 ft. or 8 m
Alkalinity (mg/L)	160	240
Conductivity (umhos)	484	513
pH	8.17	7.01
Secchi Disc (m)	1.2	---
Total Phosphorus (mg/L)	0.113	0.63
Soluble Reactive P (mg/L)	0.026	0.066
Nitrate Nitrogen (mg/L)	0.10	not measurable
Ammonia Nitrogen (mg/L)	0.10	>3.0 + Off the chart
Oxygen Sat. @ 5 ft. (%)	88.2	---
Temperature @ 5 ft. (C)	22.7	
Dissolved Oxygen @ 5 ft. (mg/L)	7.5	
Chlorophyll-a (ug/L)	Un-able to do	

Hypolimnetic reading were obtained for the first time. We were able to borrow a dissolved oxygen/temperature meter with a fifty foot cable from our good friends in LaGrange. A lot of traveling, but worth the effort.

A dissolved oxygen/temperature profile was done in both lakes.

IN-LAKE SAMPLING

Table _____

Little Chapman Lake

Date 10-5-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE 26 ft. or 8 m
Alkalinity (mg/L)	160	260
Conductivity (umhos)	604	561
pH	8.6	7.02
Secchi Disc (m)	1.0	---
Total Phosphorus (mg/L)	0.11	1.1
Soluble Reactive P (mg/L)	0.053	1.03
Nitrate Nitrogen (mg/L)	not measurable	not measurable
Ammonia Nitrogen (mg/L)	0.4	>3.0 + Off the chart
Oxygen Sat. @ 5 ft. (%)	117.6	---
Temperature @ 5 ft. (C)	22.1	
Dissolved Oxygen @ 5 ft. (mg/L)	10.	
Chlorophyll-a (ug/L)	Un-able to do	

Supporting Data

IN-LAKE SAMPLING

Table _____

Big Chapman Lake

Date 8-07-2000 Diagnostic Study

PARAMETERS	EPILIMNETIC SAMPLE	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	120	163
Conductivity (µmhos)	380	350
pH	8.4	7.6
Secchi Disc (m)	2.3	---
Total Phosphorus (mg/L)	0.03	0.082
Soluble Reactive P (mg/L)	0.014	0.011
Nitrate Nitrogen (mg/L)	0.004	0.004
Ammonia Nitrogen (mg/L)	0.313	0.460
Oxygen Sat. @ 5 ft. (%)	104.4	----
Temperature @ 5 ft. (C)	?	
Dissolved Oxygen @ 5 ft. (mg/L)	?	
Chlorophyll-a (µg/L)	~~6.56~~ 1.77	

IN-LAKE SAMPLING

Table _____

Big Chapman Lake

Date 8-11-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	150	---
Conductivity (umhos)	---	---
pH	7.85	---
Secchi Disc (m)	2.75	---
Total Phosphorus (mg/L)	0.03	---
Soluble Reactive P (mg/L)	0.007	---
Nitrate Nitrogen (mg/L)	too low to measure	---
Ammonia Nitrogen (mg/L)	0.12	---
Oxygen Sat. @ 5 ft. (%)	92.1	---
Temperature @ 5 ft. (C)	28.0	
Dissolved Oxygen @ 5 ft. (mg/L)	7.o	
Chlorophyll-a (ug/L)	Un-able to do	

No hypolimnetic reading were obtained because we could not, at this time, do a dissolved oxygen/temperature profile. We must have a dissolved oxygen/temperature meter with a fifty foot cable.

IN-LAKE SAMPLING

Table _____

Big Chapman Lake

Date 8-24-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	160	---
Conductivity (umhos)	371	---
pH	8.4	---
Secchi Disc (m)	2.6	---
Total Phosphorus (mg/L)	0.114	---
Soluble Reactive P (mg/L)	0.016	---
Nitrate Nitrogen (mg/L)	0.02	---
Ammonia Nitrogen (mg/L)	0.2	---
Oxygen Sat. @ 5 ft. (%)	88.6	---
Temperature @ 5 ft. (C)	25.4	
Dissolved Oxygen @ 5 ft. (mg/L)	7.o	
Chlorophyll-a (ug/L)	Un-able to do	

No hypolimnetic reading were obtained because we could not, at this time, do a dissolved oxygen/temperature profile. We must have a dissolved oxygen/temperature meter with a fifty foot cable.

IN-LAKE SAMPLING

Table ______

Big Chapman Lake

Date 9-7-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	160	---
Conductivity (umhos)	391	---
pH	8.47	---
Secchi Disc (m)	2.0	---
Total Phosphorus (mg/L)	0.046	---
Soluble Reactive P (mg/L)	0.02	---
Nitrate Nitrogen (mg/L)	0.02	---
Ammonia Nitrogen (mg/L)	0.15	---
Oxygen Sat. @ 5 ft. (%)	101	---
Temperature @ 5 ft. (C)	24.6	
Dissolved Oxygen @ 5 ft. (mg/L)	8.0	
Chlorophyll-a (ug/L)	Un-able to do	

No hypolimnetic reading were obtained because we could not, at this time, do a dissolved oxygen/temperature profile. We must have a dissolved oxygen/temperature meter with a fifty foot cable.

IN-LAKE SAMPLING

Table ______

Big Chapman Lake

Date 9-21-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE 29 ft. or 9 m
Alkalinity (mg/L)	180	220
Conductivity (umhos)	390	432
pH	8.36	7.58
Secchi Disc (m)	2.5	---
Total Phosphorus (mg/L)	0.066	1.63
Soluble Reactive P (mg/L)	0.026	0.046
Nitrate Nitrogen (mg/L)	0.02	0.02
Ammonia Nitrogen (mg/L)	0.2	1.4
Oxygen Sat. @ 5 ft. (%)	101.2	---
Temperature @ 5 ft. (C)	22.7	
Dissolved Oxygen @ 5 ft. (mg/L)	8.5	
Chlorophyll-a (ug/L)	Un-able to do	

Hypolimnetic reading were obtained for the first time. We were able to borrow a dissolved oxygen/temperature meter with a fifty foot cable from our good friends in LaGrange. A lot of traveling, but worth the effort.

A dissolved oxygen/temperature profile was done in both lakes.

IN-LAKE SAMPLING

Table _____

Big Chapman Lake

Date 10-5-05

PARAMETERS	EPILIMNETIC SAMPLE 5 ft. or 1.5 m	HYPOLIMNETIC SAMPLE 29 ft. or 9 m
Alkalinity (mg/L)	180	260
Conductivity (umhos)	390	463
pH	8.48	7.45
Secchi Disc (m)	2.6	---
Total Phosphorus (mg/L)	0.066	0.33
Soluble Reactive P (mg/L)	0.033	0.066
Nitrate Nitrogen (mg/L)	not measurable	not measurable
Ammonia Nitrogen (mg/L)	not measurable	2.2
Oxygen Sat. @ 5 ft. (%)	117.6	---
Temperature @ 5 ft. (C)	22.1	
Dissolved Oxygen @ 5 ft. (mg/L)	10.	
Chlorophyll-a (ug/L)	Un-able to do	

In Lake sampling, summer 2006

Water Quality Characteristics of LITTLE Chapman Lake, 2006. (mean values)

PARAMETER	EPILIMNETIC SAMPLE	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	140	204
Conductivity (umhos)	475	449
pH	8.36	7.58
Secchi Disc (m--ft)	1.0--3.29	----
Total Phosphorus (mg/L)	0.12	0.24
Soluble Reactive P (mg/L)	0.02	0.09
Nitrate Nitrogen (mg/L)	0.014	0.03
Ammonia Nitrogen (mg/L)	0.47	1.71
Oxygen Sat. @ 5 ft. (%)	108.2	----
Dissolved Oxygen @ 5 ft. (mg/L)	9.23	----
Chlorophyll=a (ug/L)	data pending	----
Turbidity (NTU)	9.24*	----
Total Suspended Solids (mg/L)	6.7**	----

All of the above reported values represent the mean value taken from five measurements for each parameter, except where indicated.

*Mean value based on three measurements.

**Mean value based on one measurement.

In Lake sampling, summer 06

Water Quality Characteristics of BIG Chapman Lake, 2006. (mean values)

PARAMETER	EPILIMNETIC SAMPLE	HYPOLIMNETIC SAMPLE
Alkalinity (mg/L)	148	212
Conductivity (umhos)	421	442
pH	8.16	7.65
Secchi Disc (m--ft)	2.32--7.63	----
Total Phosphorus (mg/L)	0.076	0.12
Soluble Reactive P (mg/L)	0.017	0.022
Nitrate Nitrogen (mg/L)	0.022	0.012
Ammonia Nitrogen (mg/L)	0.276	1.62
Oxygen Sat. @ 5 ft. (%)	95.7	----
Dissolved Oxygen @ 5 ft. (mg/L)	8.24	----
Chlorophyll=a (ug/L)	data pending	
Turbidity (NTU)	5.06*	----
Total Suspended Solids (mg/L)	3.0**	----

All of the above reported values represent the mean value taken from five measurements for each parameter, except where indicated.

*Mean value based on three measurements.

**Mean value based on one measurement.

Inlet stream mean values-summer 2006

Chemical Character and Concentration Data from the Chapman Lakes' Inlets and Outlets.

(mean values)

	Losier's Creek	Arrowhead Park	Crooked Creek	Outlet-Dam	Highland Park	Island Park
Conductivity (umhos)	632	629	707	427	733*	538**
Ammonia (mg/L)	0.63	0.53	0.51	0.60	0.70*	1.10**
Nitrate/Nitrite (mg/L)	5.10	1.90	3.70	0.26	1.70*	0.02**
Total Phosphorus (mg/L)	0.27	0.23	0.21	0.18	0.19*	0.42**
Soluble Phosphorus (mg/L)	0.07	0.11	0.14	0.04	0.10*	0.07**
pH	7.19	7.55	7.77	7.60	7.88*	6.83**
Total Dissolved Solids (mg/L)	305	310	361	211	380*	278**
E-coli (col./100 ml)	6,267	924	623	425	1,360*	1,440**
Turbidity (NTU)	6.28**	6.06**	4.87**	4.87**	----	----
Total Sus. Solids (mg/L)	1.2***	7.0***	1.0***	0.7***	----	----

All of the above measurements represent the mean value of four measurements for each parameter, except where indicated.

*Mean value of three measurements.

**Mean value of two measurements.

***One measurement.

Appendix B. Water quality data for Chapman Lakes.

TABLE A: Summary of Water Quality Data for Little Chapman Lake.

Sample Date	Secchi Disk (ft)	PH Epi/ / Hypo*	Percent Oxic	Plankton Density	TP Epi /Hypo (mg/L)*	Chl. *a* (μg/L)	TSI	Data Source
7/23/69	4.8		51%					Hudson, 1969
7/4/73	7.0		51%		0.03		25	IDEM, 1986
8/16/76	4.5	9.0 / 7.0						Shipman, 1977
8/15/89	5.9	8.9 / 7.2	33%	1150	0.040 / 0.39		24	CLP, 1989
8/15/94	4.6	8.6 / 7.5	44%	18563	0.010* / 0.30	15.13	26	CLP, 1994
6/30/98	3.6	8.6 / 7.4	78%	52715	0.02 / 0.25	11.89	37	CLP, 1998
6/7/99	4.5	8.9 / 7.9	84%					Pearson, 1999
8/7/00	4.3	8.6 / 7.5	71%	4231	0.079 / 0.217	6.56	33	JFNew, 2001
6/23/01	3.8							Volunteer monitor
7/4/01	3.2							Volunteer monitor
7/15/01	4.0							Volunteer monitor
7/24/01	4.4							Volunteer monitor
8/5/01	4.1							Volunteer monitor
8/24/01	1.7							Volunteer monitor
9/2/01	1.8							Volunteer monitor
9/12/01	1.5							Volunteer monitor
9/30/01	3.0							Volunteer monitor
6/9/02	6.3							Volunteer monitor
6/23/02	4.4							Volunteer monitor
6/23/02	2.2							Volunteer monitor
7/11/02	4.1							Volunteer monitor
7/23/02	4.6							Volunteer monitor
8/18/02	5.0							Volunteer monitor
8/25/02	6.1							Volunteer monitor
9/7/02	6.6							Volunteer monitor
9/27/02	6.6							Volunteer monitor
6/14/03	4.2							Volunteer monitor
7/13/03	3.4							Volunteer monitor
8/2/03	1.9							Volunteer monitor
8/17/03	1.5							Volunteer monitor
8/24/03	2.0							Volunteer monitor
9/8/03	1.1							Volunteer monitor
9/20/03	2.3							Volunteer monitor
10/13/03	1.5							Volunteer monitor
10/19/03	2.5							Volunteer monitor
07/07/04	2.3	8.7 / 7.7	17%	99881	0.067 / 0.123	33.19	53	CLP, 2004
7/13/04	1.7							Volunteer monitor
7/18/04	1.8							Volunteer monitor
8/1/04	2.0							Volunteer monitor
8/21/04	6.5							Volunteer monitor
9/6/04	1.5							Volunteer monitor

Sample Date	Secchi Disk (ft)	PH Epi/ / Hypo*	Percent Oxic	Plankton Density	TP Epi /Hypo (mg/L)*	Chl. *a* (μg/L)	TSI	Data Source
9/12/04	2.6							Volunteer monitor
9/19/04	2.6							Volunteer monitor
5/30/05	1.5							Volunteer monitor
7/3/05	1.5							Volunteer monitor
7/25/05	2.0							Volunteer monitor
8/15/05	1.5							Volunteer monitor
9/6/05	1.5							Volunteer monitor
10/18/05	1.5							Volunteer monitor
10/24/05	1.5							Volunteer monitor
4/14/06	1.0							Volunteer monitor
5/3/06	1.3							Volunteer monitor
6/11/06	1.6							Volunteer monitor
7/7/06	3.4							Volunteer monitor
7/9/06	5.5							Volunteer monitor
7/17/06	3.2							Volunteer monitor
7/25/06	1.5							Volunteer monitor
8/1/06	2.8							Volunteer monitor
8/19/06	3.2							Volunteer monitor
8/28/06	2.6							Volunteer monitor
9/17/06	0.2							Volunteer monitor

*epilimnetic value unless a hypolimnetic value is included after the /

TABLE B: Water Quality Characteristics of Little Chapman Lake, 1989.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.9	7.2	-
Alkalinity	225 mg/L	297 mg/L	-
Conductivity	790 μmhos	790 μmhos	-
Secchi Depth Transparency	1.8 meters	-	0
Light Transmission @ 3 ft.	30%	-	4
1% Light Level	14 feet	-	-
Total Phosphorus	0.040 mg/L	0.389 mg/L	4
Soluble Reactive Phosphorus	0.003 mg/L	0.340 mg/L	3
Nitrate-Nitrogen	2.314 mg/L	7.303 mg/L	4
Ammonia-Nitrogen	0.052 mg/L	3.582 mg/L	4
Organic Nitrogen	0.945 mg/L	0.833 mg/L	2
Oxygen Saturation @ 5ft.	108.3%	-	0
% Water Column Oxic	44.4%	-	3
Plankton Density	1150 per L	-	0
Blue-Green Dominance	42.1% - No	-	0
		TSI Score	**24**

TABLE C: Water Quality Characteristics of Little Chapman Lake, 1994.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.6	7.5	-
Alkalinity	124 mg/L	196.5 mg/L	-
Conductivity	370 μmhos	370 μmhos	-
Secchi Depth Transparency	1.4 meters	-	6
Light Transmission @ 3 ft.	23%	-	4
1% Light Level	11 feet	-	-
Total Phosphorus	0 mg/L	0.3 mg/L	3
Soluble Reactive Phosphorus	0 mg/L	0.253 mg/L	3
Nitrate-Nitrogen	0.022 mg/L	0.022 mg/L	0
Ammonia-Nitrogen	0.018 mg/L	1.989 mg/L	4
Organic Nitrogen	0.425 mg/L	0.618 mg/L	1
Oxygen Saturation @ 5ft.	106%	-	0
% Water Column Oxic	65%	-	2
Plankton Density	18563 per L	-	3
Blue-Green Dominance	35.25% - No	-	0
Chlorophyll *a*	15.13 μg/L	-	-
		TSI Score	**26**

TABLE D: Water Quality Characteristics of Little Chapman Lake, 1998.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.6	7.4	-
Alkalinity	125.5 mg/L	180 mg/L	-
Conductivity	370 μmhos	350 μmhos	-
Secchi Depth Transparency	1.1 meters	-	6
Light Transmission @ 3 ft.	27.54%	-	4
1% Light Level	9.6 feet	-	-
Total Phosphorus	0.02 mg/L	0.246 mg/L	3
Soluble Reactive Phosphorus	0.002 mg/L	0.219 mg/L	3
Nitrate-Nitrogen	0.022 mg/L	0.022 mg/L	0
Ammonia-Nitrogen	0.018 mg/L	0.073 mg/L	0
Organic Nitrogen	0.53 mg/L	1.265 mg/L	2
Oxygen Saturation @ 5ft.	128%	-	2
% Water Column Oxic	50%	-	2
Plankton Density	52715 per L	-	5
Blue-Green Dominance	52.84%- Yes	-	10
Chlorophyll *a*	11.89 μg/L	-	-
		TSI Score	**37**

TABLE E. Water Quality Characteristics of Little Chapman Lake, 2000.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.6	7.5	-
Alkalinity	126 mg/L	182 mg/L	-
Conductivity	368.8 µmhos	402.1 µmhos	-
Secchi Depth Transparency	1.3 meters	-	6
Light Transmission @ 3 ft.	45%	-	3
1% Light Level	13 feet	-	-
Total Phosphorus	0.079 mg/L	0.217 mg/L	3
Soluble Reactive Phosphorus	0.013 mg/L	0.173 mg/L	3
Nitrate-Nitrogen	0.013 mg/L	0.013 mg/L	0
Ammonia-Nitrogen	0.018 mg/L	1.251 mg/L	3
Organic Nitrogen	1.329 mg/L	2.063 mg/L	3
Oxygen Saturation @ 5ft.	102%	-	0
% Water Column Oxic	71%	-	1
Plankton Density	4231 per L	-	1
Blue-Green Dominance	52% - Yes	-	10
Chlorophyll *a*	6.56 µg/L	-	-
		TSI Score	**33**

TABLE F. Water Quality Characteristics of Little Chapman Lake, 2004.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.7	7.7	-
Alkalinity	143 mg/L	172 mg/L	-
Conductivity	416 µmhos	392 µmhos	-
Secchi Depth Transparency	0.7 meters	-	6
Light Transmission @ 3 ft.	40%	-	3
1% Light Level	7.2 feet	-	-
Total Phosphorus	0.067 mg/L	0.123 mg/L	4
Soluble Reactive Phosphorus	0.010 mg/L	0.066 mg/L	1
Nitrate-Nitrogen	0.013 mg/L	0.013 mg/L	0
Ammonia-Nitrogen	0.056 mg/L	0.857 mg/L	2
Organic Nitrogen	0.941 mg/L	1.325 mg/L	3
Oxygen Saturation @ 5ft.	96.2%	-	0
% Water Column Oxic	17%	-	4
Plankton Density	99,881 per L	-	15
Blue-Green Dominance	97% - Yes	-	10
Chlorophyll *a*	33.2 µg/L	-	-
		TSI Score	**48**

TABLE G. Summary of Water Quality Data for Big Chapman Lake.

Sample Date	Secchi Disk (ft)	pH Epi /Hypo	Percent Oxic	Plankton Density	Total Phos. Epi /Hy (mg/L)*	Chl. *a* (□g/L)	TSI	Data Source
6/4/64	12.0		100%					McGinty, 1964
5/20/65		8.3 (epi)						McGinty, 1965
7/4/73	10.0				0.01		18	IDEM, 1986
8/9/76		9.0/ 7.5	55%					Shipman, 1976
4/24/89	9.5							Volunteer monitor
5/5/89	11.3							Volunteer monitor
5/19/89	19.8							Volunteer monitor
6/2/89	17.8							Volunteer monitor
6/16/89	12.3							Volunteer monitor
6/30/89	13.5							Volunteer monitor
7/14/89	9.5							Volunteer monitor
7/28/89	10.0							Volunteer monitor
8/11/89	8.3							Volunteer monitor
8/25/89	7.0							Volunteer monitor
9/8/89	6.5							Volunteer monitor
9/22/89	6.3							Volunteer monitor
4/27/90	19.5							Volunteer monitor
5/11/90	12.5							Volunteer monitor
5/25/90	13.5							Volunteer monitor
6/8/90	17.0							Volunteer monitor
6/22/90	10.8							Volunteer monitor
7/6/90	6.3							Volunteer monitor
7/20/90	7.5							Volunteer monitor
8/3/90	7.3							Volunteer monitor
8/17/90	6.5							Volunteer monitor
8/31/90	8.0							Volunteer monitor
9/14/90	8.0							Volunteer monitor
9/28/90	7.5							Volunteer monitor
10/12/90	8.8							Volunteer monitor
6/1/91	12.5							Volunteer monitor
6/10/91	9.0	8.1 / 7.9	45%					Pearson, 1991
6/15/91	7.0							Volunteer monitor
6/27/91	9.0							Volunteer monitor
7/12/91	7.0							Volunteer monitor
8/3/91	9.0							Volunteer monitor
8/16/91	9.0							Volunteer monitor
8/30/91	8.0							Volunteer monitor
9/20/91	6.5							Volunteer monitor
10/3/91	6.0							Volunteer monitor
10/13/91	7.5							Volunteer monitor
5/22/92	16.5							Volunteer monitor
6/5/92	18.0							Volunteer monitor

Sample Date	Secchi Disk (ft)	pH Epi /Hypo	Percent Oxic	Plankton Density	Total Phos. Epi /Hy (mg/L)*	Chl. *a* (□g/L)	TSI	Data Source
6/20/92	12.5				0.037	1.28		Volunteer monitor
7/11/92	8.0				0.058	1.80		Volunteer monitor
7/19/92	8.5							Volunteer monitor
8/2/92	8.5							Volunteer monitor
8/23/92	7.0				0.03	0.07		Volunteer monitor
9/14/92	7.5							Volunteer monitor
9/30/92					0.033	0.97		Volunteer monitor
10/2/92	7.0							Volunteer monitor
5/27/93	13.0							Volunteer monitor
6/20/93	13.0				0.01	0		Volunteer monitor
7/11/93	9.0				0.01	1.25		Volunteer monitor
7/29/93	6.5							Volunteer monitor
8/13/93	8.0							Volunteer monitor
8/17/93	7.0				0.01	2.77		Volunteer monitor
9/16/93	8.0				0.017	5.49		Volunteer monitor
10/2/93	7.0				0.023	5.49		Volunteer monitor
5/20/94	13.0				0.011	1.39		Volunteer monitor
6/6/94	11.0				0.017	2.29		Volunteer monitor
6/24/94	8.0							Volunteer monitor
7/4/94	9.0							Volunteer monitor
7/5/94	8.0							Volunteer monitor
7/13/94	8.0				0.0275	2.56		Volunteer monitor
8/15/94	8.9	8.4 / 7.6	63%	8603	0.014 / 0.055	3.22	5	CLP, 1994
8/15/94					0.02	3.47		Volunteer monitor
8/19/94	9.0							Volunteer monitor
9/15/94	10.0				0.0405	2.82		Volunteer monitor
9/29/94	8.5							Volunteer monitor
10/8/94	11.0							Volunteer monitor
10/23/94	12.3							Volunteer monitor
5/12/95	10.0							Volunteer monitor
5/21/95	12.0				0.02	0		Volunteer monitor
6/10/95					0.018	4.58		Volunteer monitor
7/4/95	10.0							Volunteer monitor
7/17/95	8.0							Volunteer monitor
7/20/95	8.0				0.014	3.42		Volunteer monitor
8/13/95	10.5				0.004	0.21		Volunteer monitor
9/9/95					0.004	3.08		Volunteer monitor
5/16/96	6.0							Volunteer monitor
5/30/96	12.0							Volunteer monitor
6/27/96	12.5							Volunteer monitor
7/3/96	8.0							Volunteer monitor
7/14/96	7.0				0.023	1.36		Volunteer monitor
7/29/96	12.0				0.027	1.98		Volunteer monitor

Sample Date	Secchi Disk (ft)	pH Epi /Hypo	Percent Oxic	Plankton Density	Total Phos. Epi /Hy (mg/L)*	Chl. *a* (g/L)	TSI	Data Source
8/22/96	7.5				0.024	2.80		Volunteer monitor
9/17/96	7.0				0.024	4.03		Volunteer monitor
9/30/96	7.5							Volunteer monitor
5/17/97	9.6							Volunteer monitor
5/21/97	9.2				0.027			Volunteer monitor
6/27/97	8.2				0.018	2.73		Volunteer monitor
7/22/97	7.7				0.017	4.47		Volunteer monitor
8/4/97	7.7							Volunteer monitor
8/17/97	8.0				0.021	5.91		Volunteer monitor
8/31/97	9.2							Volunteer monitor
9/13/97	9.3							Volunteer monitor
10/5/97	12.2							Volunteer monitor
5/12/98	16.2							Volunteer monitor
5/23/98	14.0				0.024	0.99		Volunteer monitor
6/7/98	10.2							Volunteer monitor
6/18/98	10.1				0.017	2.17		Volunteer monitor
6/30/98	10.2	8.3 / 7.5	63%	17943	0.015 / 0.025	2.58	7	CLP, 1998
7/6/98	7.5							Volunteer monitor
7/31/98	9.2				0.012	0.17		Volunteer monitor
8/20/98	9.6				0.016	1.83		Volunteer monitor
9/12/98	9.2							Volunteer monitor
10/8/98	9.9							Volunteer monitor
5/9/99	12.2							Volunteer monitor
5/26/99	10.2				0.035	0.37		Volunteer monitor
6/1/99	12.0	8.9 / 8.2	82%					Pearson, 1999
6/9/99	15.8							Volunteer monitor
6/23/99	15.4				0.032	8.17		Volunteer monitor
7/7/99	8.4							Volunteer monitor
7/22/99	10.3				0.054	1.56		Volunteer monitor
8/13/99	6.9							Volunteer monitor
8/25/99	9.2				0.043	2.14		Volunteer monitor
9/13/99	6.6							Volunteer monitor
9/27/99	7.2							Volunteer monitor
10/10/99	11.9							Volunteer monitor
5/8/00	14.1							Volunteer monitor
5/26/00	17.3				0.047	0.20		Volunteer monitor
6/19/00	10.1				0.061	2.20		Volunteer monitor
7/3/00	9.0							Volunteer monitor
7/24/00	6.1				0.035	1.97		Volunteer monitor
8/7/00	7.6	8.4 / 7.6	55%	2203	0.03 / 0.082	1.77	20	JFNew, 2001
8/14/00	7.8				0.049	1.58		Volunteer monitor
9/7/00	7.6							Volunteer monitor
9/20/00	7.7							Volunteer monitor

Sample Date	Secchi Disk (ft)	pH Epi /Hypo	Percent Oxic	Plankton Density	Total Phos. Epi /Hy (mg/L)*	Chl. *a* (□g/L)	TSI	Data Source
10/17/00	11.1							Volunteer monitor
5/12/01	17.3							Volunteer monitor
6/4/01	11.5							Volunteer monitor
6/26/01	5.5							Volunteer monitor
7/6/01	5.5							Volunteer monitor
7/24/01	8.0							Volunteer monitor
8/13/01	7.1							Volunteer monitor
8/30/01	7.2							Volunteer monitor
9/15/01	8.4							Volunteer monitor
5/24/02	9.0							Volunteer monitor
6/18/02	12.8							Volunteer monitor
7/8/02	7.3							Volunteer monitor
7/19/02	7.7							Volunteer monitor
7/24/02	7.7							Volunteer monitor
8/26/02	12.0							Volunteer monitor
9/13/02	11.2							Volunteer monitor
10/4/02	10.5							Volunteer monitor
5/25/03	10.0							Volunteer monitor
6/30/03	9.2							Volunteer monitor
7/28/03	8.0							Volunteer monitor
8/31/03	9.0							Volunteer monitor
5/29/04	11.0							Volunteer monitor
5/29/04	9.9							Volunteer monitor
6/30/04	9.4							Volunteer monitor
7/7/04	7.2	8.3 / 7.8	55%	3520	0.043 / 0.54	3.32	20	CLP, 2004
7/29/04	8.9							Volunteer monitor
7/29/04	8.2							Volunteer monitor
6/11/06	3.5							Volunteer monitor
6/24/06	4.8							Volunteer monitor
7/7/06	5.7							Volunteer monitor
7/17/06	8.0							Volunteer monitor
8/1/06	7.0							Volunteer monitor
8/19/06	6.2							Volunteer monitor
8/28/06	6.3							Volunteer monitor

*epilimnetic value unless a hypolimnetic value is included after the /

TABLE H. Water Quality Characteristics of Big Chapman Lake, 1994.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.4	7.6	-
Alkalinity	126 mg/L	179 mg/L	-
Conductivity	370 μmhos	385 μmhos	-
Secchi Depth Transparency	2.7 meters	-	0
Light Transmission @ 3 ft.	54%	-	2
1% Light Level	23 feet	-	-
Total Phosphorus	0.014 mg/L	0.055 mg/L	1
Soluble Reactive Phosphorus	0	0	0
Nitrate-Nitrogen	0.022 mg/L	0.022 mg/L	0
Ammonia-Nitrogen	0.018 mg/L	0.502 mg/L	0
Organic Nitrogen	0.378 mg/L	0.590 mg/L	0
Oxygen Saturation @ 5 ft.	95%	-	0
% Water Column Oxic	85%	-	0
Plankton Density	8603 per L	-	2
Blue-Green Dominance	32%- No	-	0
Chlorophyll *a*	3.22 μg/L	-	-
		TSI Score	**5**

TABLE I. Water Quality Characteristics of Big Chapman Lake, 1998.

Parameter	**Epilimnetic Sample**	**Hypolimnetic Sample**	**Indiana TSI Points (based on mean values)**
pH	8.26	7.5	-
Alkalinity	123.9 mg/L	165.7 mg/L	-
Conductivity	380 μmhos	340 μmhos	-
Secchi Depth Transparency	3.1 meters	-	0
Light Transmission @ 3 ft.	55.59%	-	2
1% Light Level	20.3 feet	-	-
Total Phosphorus	0.015 mg/L	0.025 mg/L	0
Soluble Reactive Phosphorus	0.002 mg/L	0.003 mg/L	0
Nitrate-Nitrogen	0.022 mg/L	0.022 mg/L	0
Ammonia-Nitrogen	0.018 mg/L	0.307 mg/L	0
Organic Nitrogen	0.429 mg/L	0.104 mg/L	0
Oxygen Saturation @ 5 ft.	106%	-	0
% Water Column Oxic	63.63%	-	2
Plankton Density	17570 per L	-	3
Blue-Green Dominance	16% - No	-	0
Chlorophyll *a*	2.58 μg/L	-	-
		TSI Score	**7**

TABLE J. Water Quality Characteristics of Big Chapman Lake, 200.

Parameter	Epilimnetic Sample	Hypolimnetic Sample	Indiana TSI Points (based on mean values)
pH	8.4	7.6	-
Alkalinity	120 mg/L	163 mg/L	-
Conductivity	380 μmhos	349.9 μmhos	-
Secchi Depth Transparency	2.3 meters	-	0
Light Transmission @ 3 ft.	50%	-	3
1% Light Level	23.5 feet	-	-
Total Phosphorus	0.03 mg/L	0.082 mg/L	2
Soluble Reactive Phosphorus	0.014 mg/L	0.011 mg/L	0
Nitrate-Nitrogen	0.004 mg/L	0.004 mg/L	0
Ammonia-Nitrogen	0.313 mg/L	0.460 mg/L	1
Organic Nitrogen	0.2 mg/L	1.225 mg/L	2
Oxygen Saturation @ 5ft.	104.4%	-	0
% Water Column Oxic	54%	-	2
Plankton Density	2203	-	0
Blue-Green Dominance	67% -Yes	-	10
Chlorophyll *a*	1.77 μg/L	-	-
		TSI Score	**20**

TABLE K. Water Quality Characteristics of Big Chapman Lake, 2004.

Parameter	Epilimnetic Sample	Hypolimnetic Sample	Indiana TSI Points (based on mean values)
pH	8.3	7.8	-
Alkalinity	140 mg/L	165 mg/L	-
Conductivity	411 μmhos	378 μmhos	-
Secchi Depth Transparency	2.2 meters	-	0
Light Transmission @ 3 ft.	60%	-	2
1% Light Level	17.4 feet	-	-
Total Phosphorus	0.043 mg/L	0.054 mg/L	2
Soluble Reactive Phosphorus	0.010 mg/L	0.010 mg/L	0
Nitrate-Nitrogen	0.013 mg/L	0.013 mg/L	0
Ammonia-Nitrogen	0.046 mg/L	0.607 mg/L	1
Organic Nitrogen	0.581 mg/L	0.935 mg/L	2
Oxygen Saturation @ 5ft.	87.7%	-	0
% Water Column Oxic	55%	-	2
Plankton Density	3520 per L	-	1
Blue-Green Dominance	82.2% - Yes	-	10
Chlorophyll *a*	3.32 μg/L	-	-
		TSI Score	**20**

TABLE L. Data from the biotic assessment of Crooked Creek as sampled on April 26, 2002.

Metric	# or %	Score
# of species	4	3
# of DMS species	1	5
% headwater species	44.3	5
# of minnow species	2	5
# of sensitive species	2	5
% tolerant individuals	55.7	1
% omnivorous individuals	0	5
% insectivorous individuals	44.3	3
% pioneer species	11.5	5
Catch per unit effort	61	3
% simple lithophilic individuals	77	5
% DELT individuals	0	5
IBI Score		**50**
Integrity class		**Good**

DMS = darter, madtom, sculpin
DELT = deformities, erosion, lesions, tumors

TABLE M. Data from the biotic assessment of Arrowhead Drain as sampled on April 26, 2002.

Metric	# or %	Score
# of species	5	3
# of DMS species	2	5
% headwater species	10.3	5
# of minnow species	3	5
# of sensitive species	1	5
% tolerant individuals	2.6	5
% omnivorous individuals	<50 Individuals	1
% insectivorous individuals	<50 Individuals	1
% pioneer species	5.1	5
Catch per unit effort	39	3
% simple lithophilic individuals	<50 Individuals	1
% DELT individuals	<50 Individuals	1
IBI Score		**40**
Integrity class		**Fair**

TABLE N. Qualitative Habitat Evaluation Index Scores for Chapman Lakes' tributaries.

Site	Substrate Score	Cover Scor	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Score	Total Score
Maximum Possible Score	20	20	20	10	12	8	10	**100**
Crooked Creek	18	12	18	10	5	5	10	**78**
Arrowhead Drain	13	6	9	9	3	2	8	**50**
William Gilliam Drain	7	11	18	9	4	1	4	**54**
William Bixler Drain	7	13	13	8	0	0	4	**45**
Highland Park Drain	1	8	6	5	0	0	4	**24**

TABLE O. Data from the biotic assessment of Gilliam Drain as sampled on August 1, 2005.

		Metric Score
HBI	5.4	2
No. Taxa (family)	6.0	0
No. Individuals	34.0	0
% Dominant Taxa	0.6	0
EPT Index	0.0	0
EPT Count	0.0	0
EPT Count/Total Count	0.0	0
EPT Abundance/Chironomid Abundance	0.0	0
Number of Individuals Per Square	0.4	0
Chironomid Count	21.0	4
mIBI Score		0.6

TABLE P. Data from the biotic assessment of Bixler Drain as sampled on August 1, 2005.

		Metric Score
HBI	5.4	2
No. Taxa (family)	4.0	0
No. Individuals	39.0	0
% Dominant Taxa	0.6	2
EPT Index	1.0	0
EPT Count	1.0	0
EPT Count/Total Count	0.0	0
EPT Abundance/Chironomid Abundance	0.0	0
Number of Individuals Per Square	0.5	0
Chironomid Count	24.0	4
mIBI Score		0.8

APPENDIX C – Selected Chapman Lakes 2005 Resident Survey Data:

Respondent demographics:

Education level:	
Some high school	0.95%
Finished high school or GED	26.07%
Some college	27.49%
Finish college	22.75%
Graduate Degree	22.75%

Household annual income	
Less than $30,000	12.42%
$31,000-$50,000	13.73%
$51,000-$100,000	35.95%
More than $100,000	37.91%

Age:	
20 years or younger	1.02%
21-30	1.02%
31-50	29.95%
51-70	41.62%
70 years or older	26.40%

Profession/occupation:	
Manufacturing	13.42%
Retail Trade	5.19%
Health Care and Soci Services	6.06%
Educational Services	6.49%
Accommodation and Foo Services	0.87%
Construction	3.46%
Public Administration	0.00%
Agriculture	1.30%
Professional/Technical	21.21%
other (retired)	41.99%

About your property on the lake:

1. Are you:

Owner	96.68%
Tenant	3.32%
Corporate Owner	0.00%

2. Years occupied/owned th property:

Less than 3 years	11.42%
3-5 years	12.79%
6-10 years	19.63%
11-15 years	9.59%
More that 15 years	46.58%

3. Occupied when:

Year around	52.54%
Summer	22.03%
Weekends	20.76%
Others	4.66%

4. General location your property on the lake:

Big Chapman	**80.68%**	**Little Chapman**	**19.32%**
Nellie Bay	11.38%	Between the Lakes Channel	10.00%
East Side to Public Ramp	23.95%	North End	35.00%
South Side From Public Ramp and West	18.56%	East Side to Lozier's	42.50%
Osborn's Landing	10.18%	Lozier's	5.00%
West Side	3.59%	other	7.50%
Island Park	8.38%		
Chapman Lake Park	15.57%		
Lake Forest	8.38%		

5. Which of these best describ your location?

Frontage	66.53%
Channel	26.03%
Neither (deeded access)	7.44%

About your lake use:

6. We spend most of our time on the :

Big Chapman Lake	71.37%
Little Chapman lake	20.33%
Fishing areas	8.30%

7. When not at Chapman Lakes, we spend most of our time on lakes or or rivers in

Northern Indiana	27.36%	2	Western US	1.89%
Midwest	23.58%	7	Outside the United States	6.60%
Southern United States	18.87%	21	We don't use other waters	19.81%
Eastern United States	1.89%			

8. What kinds of watercraft c you use on Chapman lakes

Row boat	9.83%	63	Paddle boat	11.69%
Ski boat	14.47%	27	Bass bo	5.01%
Personal watercraft	12.80%	48	Outboard fishir boat	8.91%
Sailboat	3.71%	134	Pontoon/Deck boa	24.86%
Canoe	6.49%	12	other	2.23%

9. In what kinds of activities c you participate on Chapman Lake

Fish	23.63%	164	Swim in lake	23.63%
Power boat	15.13%	90	Water sl	12.97%
Non-motorized boat	11.24%	15	Sail	2.16%
Personal watercraft	10.95%	2	SCUBA	0.29%

10. In season, how often are yc on the lakes

1 or 2 times a week	58.68%
3 or 4 times a week	23.55%
5 or 6 times a week	8.68%
Daily	9.09%

11. When are you usually on tl lakes

Holidays only	2.38%
Weekends only	17.62%
Weekdays only	9.05%
Combination of Weekends ar weekdays	70.95%

12. How often during the season do you use shallow shorelines and/ picnic areas

1. Southeast Big Chapma shallow:

Less than 2 times a week	11.98%
Weekends	8.33%
1 Time a month	29.69%
Never	50.00%

2. Northwest Big Chapma shallows

Less than 2 times a week	8.62%
Weekends	12.64%
1 Time a month	28.16%
Never	50.57%

3. Little Chapman Floating

Less than 2 times a week	15.76%
Weekends	17.39%
1 Time a month	29.35%
Never	37.50%

About your perception of problems and concerns at the lake

13. In general, human use of the lake has

Increased	87.18%
No change	9.83%
Decreased	2.99%

14. In general, water clarity is

Better	16.19%
No changer	45.24%
Worse	38.57%

15. In general Fishing is:

Better	8.05%
No change	56.90%
Worse	35.06%

16. Biggest Lake Problem? How items ranked:

Item (Highest score = Worst)	
Septic systems and sewers	53.95%
Aquatic plant management	51.67%
Boats and personal watercraft	45.90%
Urban development	41.24%
Water quality, clarity and depth	39.46%
Law enforcement and compliance	34.55%
Shoreline, habitat and dam/levee management	33.96%
Local control	30.53%
Public access	22.69%
Storm run-off, erosion control, and watershed management	18.22%

17. Which of the following problems have occurred at near your property in the past 5 years

Lake high water over the shore/seawall estimated times	1.33%
Ditch overflow onto your property estimated times	1.33%
Sediment build-up in lake	34.00%
Lake weed build up at your location	56.00%
No Change or nothing observed	7.33%

18. Actions you would be willing to take to improve water quality ar lake ecology:

A. Boating and fishing

Reduce boat speed in designate shallow areas of the lake, including offsho areas less that 5 feet deep	25.60%
Not use motorized boats during a given time of day to reduce noise and wa action	8.32%
Replace an older boat motor that is inefficient or leaking fuel or oil	13.28%
Take steps to prevent oil or gas leaks and spills in the lake	20.00%
Clean and dry all equ9ipment before transporting it between lake to avc spreading aquatic nuisance	14.88%
Not dump live bait in the lake after fishing	17.92%

b. Property management:

Redirect storm water, drains and gutters away from the lake	9.47%
Maintain my septic system by pumping every 2 years	20.12%
Pay to hook up my lake property to a sewer system	17.16%
Place glacial stone in front of my concrete seawall to provide habitat ar decrease wave reflection	6.36%
Establish a buffer of flowers and decorative grasses between my lawn and tl lake to avoid mowing or fertilizing turf close to the lakeshore	7.99%
Use only fertilizer that contains no or low amounts of phosphorus	20.27%
Contribute to the aquatic plant control fund	18.64%

19. What is your most trusted source of information about lal issues?

Chapman Lakes website	18.26%
Making Waves association newsletter	55.69%
Local Newspapers	11.08%
Local TV news	0.00%
Radio Stations	0.00%
IDNR fish and wildlife biologists	4.79%
Local bait shop	1.20%
DNR Publications or websites	4.49%
University research publications or website	1.50%
Professional anglers or hunters	0.60%
other	2.40%

Membership in community organizations:

20. Are you a CLCA member

Yes	81.53%
If not, what would it take to convince you to	5.86%
No	12.61%

21. Have you contributed financially to CLCA sponsored:

Independence Day?	62.50%
If not, how could we encourage you to participate in the future:	10.81%
Lake Enhancement Fund	26.69%

22. Have you contributed your time to CLCA sponsored:

Independence Day	25.00%
Lake Enhancement projects	27.42%
Other	32.26%
If not, how could we encourage you to participate in the future?	15.32%

22. In what other local organizations are you active?

Church	51.37%
Fishing or hunting clubs	6.56%
Boating clubs	1.64%
Sports leagues	12.02%
Service organizations	28.42%

Your final comments			

23. What do you like most the lake:	**236**
views	15.25%
atmosphere/people	17.37%
water quality	16.53%
piece/tranquility	18.22%
wildlife	6.78%
Big lake, little lake combo	6.78%
fishing, swimming, boating	19.07%

24. What bothers you mo at the lake	**208**
wildlife trouble	2.40%
personal watercraft	12.02%
boat noise	5.77%
boating laws	24.52%
over crowding	12.02%
lack of enforcing	4.81%
road speed	2.40%
inconsiderate people	13.46%
funneling/zoning	1.92%
weeds and sediment	20.67%

25. Other comments

weeds and sewer

26. Are you a contributor to the Chapma Lakes Foundation	**100**
Yes	70.00%
No	30.00%

Resources

Helpful Internet Informational Links:

Permits/Requirements:
Various— http://www.in.gov/dnr/water/permits/application_manual/index.html
Dredging— www.in.gov/idem/guides/permit/water/dredgingpermits.html
Seawalls, Ditches, Gravel, etc.— http://www.in.gov/ai/demoz/dnr_water_permit/
US Army Corps of Engineers, Louisville Dist.--http://www.lrl.usace.army.mil/home.htm
Indiana Department of Environmental Management (IDEM).— http://www.in.gov/idem/permits/

Depending upon your proposed project, you may need permits from the Indiana Department of Natural Resources (IDNR), Indiana Department of Environmental Management (IDEM) and/or the U.S. Army Corps of Engineers. Other than county drainage board, soil and water conservation district (SWCD), or surveyor, local government offices may not be familiar with requirements and usually have no jurisdiction over lake and watershed permit matters. Excavation contractors are seldom helpful with permits. [Notice: Sponsors of this plan assume no responsibility for the validity nor accuracy of any link listed here and are presented as a public service only.]

Other Links from the Chapman Lakes Conservation Association web pages http://www.chapmanlake.com include:

—**LARE PROGRAM**—Indiana Lakes and River Enhancement program. Permit brochures, aquatic plant management info, more.
http://www.in.gov/dnr/soilcons/programs/lare.html

—INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (IDEM)—
Office of water quality:http://www.in.gov/idem/water/index.html.
Watershed management: http://www.in.gov/idem/water/planbr/wsm/index.html.
Biological studies: http://www.in.gov/idem/water/assessbr/biostud/index.html,

—KOSCIUSKO COUNTY GOVERNMENT WEB SITE. Get GIS maps of your property. Find out about your property assessed value, and much more. LINK: http://www.kcgov.com

—Purdue University Water Quality page. With the companion site below, drinking water, wellhead protection, land uses, etc. LINK: http://www.ces.purdue.edu/waterquality

—PURDUE UNIVERSITY SAFE WATER site. With the site above, find publications, “HomeASyst” program for self evaluation. LINK: http://ecn.purdue.edu/safewater

—INDIANA LAKES INFORMATION—Environmental and management issues. LINK: http://www.state.in.us/indianalakes

—Indiana Clean Lakes Program —IU’s Bill Jones and IDEM’s Carol Newhouse. LINK: http://www.spea.indiana.edu/clp/

—J. F. NEW & ASSOCIATES. Contractor web site for many Chapman Lakes projects. Describes firm and has contact information.
LINK: http://www.jfnew.com

—U.S. FISH & WILDLIFE SERVICE. Web site for information, news, etc. LINK: http://www.fws.gov

—NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION. Web site for information. LINK: http://www.noaa.gov

—U.S. ENVIRONMENTAL PROTECTION AGENCY. Office of wetlands, oceans, watersheds. LINK: http://www.epa.gov/owow